Merrell Design Services
Practical Structural Solutions

STRUCTURAL CALCULATIONS

Cheshire Upper Lot Residence

PROJECT LOCATION

7615 E Mercer Way
Mercer Island, WA

BY
KEVIN J. HAIAR, P.E.

MERRELL DESIGN SERVICES PLLC

SPOKANE, WA

REV 1: 3/28/25
CLARIFIED SEISMIC CRITERIA & LATERAL DESIGN

REV 2: 6/10/25
SITE RETAINING WALL DESIGN ADDED

DATE
12/15/24

REV 3: 7/29/25
PIN PILES, HELICAL PILES, AND CATCHMENT WALL ADDED, SITE RET WALL UPDATED

TABLE R301.2(1)
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

ROOF SNOW LOAD [a] (psf)	WIND DESIGN				SEISMIC DESIGN CATEGORY	SUBJECT TO DAMAGE FROM			OUTDOOR DESIGN TEMP (F) - Heat/Cool	ICE BARRIER UNDERLAYMENT REQUIRED	FLOOD HAZARD[e]	AIR FREZING INDEX	MEAN ANNUAL TEMP
	Speed [b] (mph)	Topographic effects[c]	Special wind region	Windborne debris zone		Weathering[d]	Frost line depth	Termite					
25	110	Yes	No	No	D2	Moderate	12”	Slight to Moderate	83/24	No	N.A.	113	53

MANUAL J DESIGN CRITERIA							
Elevation	Latitude	Winter heating	Summer cooling	Altitude correction factor	Indoor design temperature	Design temperature cooling	Heating temperature difference
338 feet	47°34’39’’	72°F max	75°F min	0.99	72°F	75°F	48°F
Cooling temperature difference	Wind velocity heating	Wind velocity cooling	Coincident wet bulb	Daily range	Winter humidity	Summer humidity	
8°F	N.A.	N.A.	66	Medium	75%	68%	

a. This is the minimum roof snow load. When using this snow load it will be left to the engineer’s judgment whether to consider drift or sliding snow. However, rain on snow surcharge of 5 psf must be considered for roof slopes less than 5 degrees.

b. The 110 mph Ultimate Design Wind Speed (3-second gust) as adopted by the 2018 IRC/ASCE 7-10 (or if using the IBC for structural design, the 98 mph Basic Design Wind Speed as adopted by the 2018 IBC/ASCE 7-16 may be used).

c. Wind exposure category and Topographic effects (Wind Speed-up Kzt factor) shall be determined on a site-specific basis by the Engineer of Record (components and cladding need not consider topographic effects unless otherwise determined by the engineer of record).

d. Weathering may require a higher strength concrete or grade of masonry than necessary to satisfy the structural requirements of this code. The grade of masonry units shall be determined from ASTM C 34, C 55, C 62, C 73, C 90, C 129, C 145, C 216 or C 652.

e. The City of Mercer Island participates in the National Flood Insurance Program (NFIP); Regular Program (No Special Flood Hazard Area). Further NFIP participation information: CID 530083, Initial FHBM Identified 06/28/74, Initial FIRM Identified 05/16/95, Current Effective Map Date (NSFHA), Reg-Emer Date 06/30/97, 53033C0654G effective 8/19/2020.

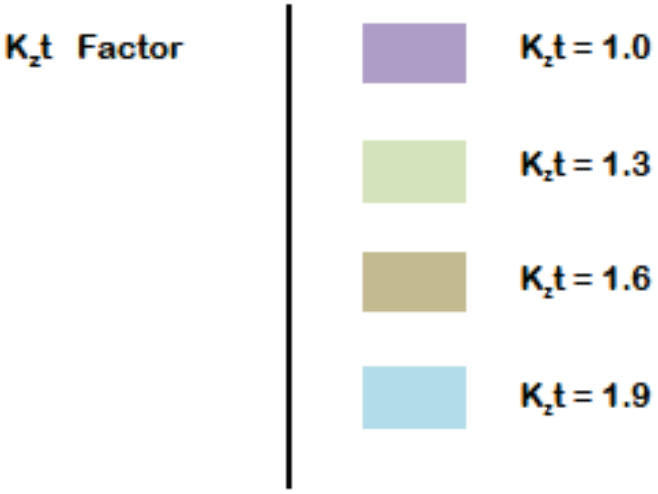
WIND EXPOSURE CATEGORIES & WIND SPEED-UP FACTORS
(ICC Section 1609 & ASCE 7-05 Chapter 6)

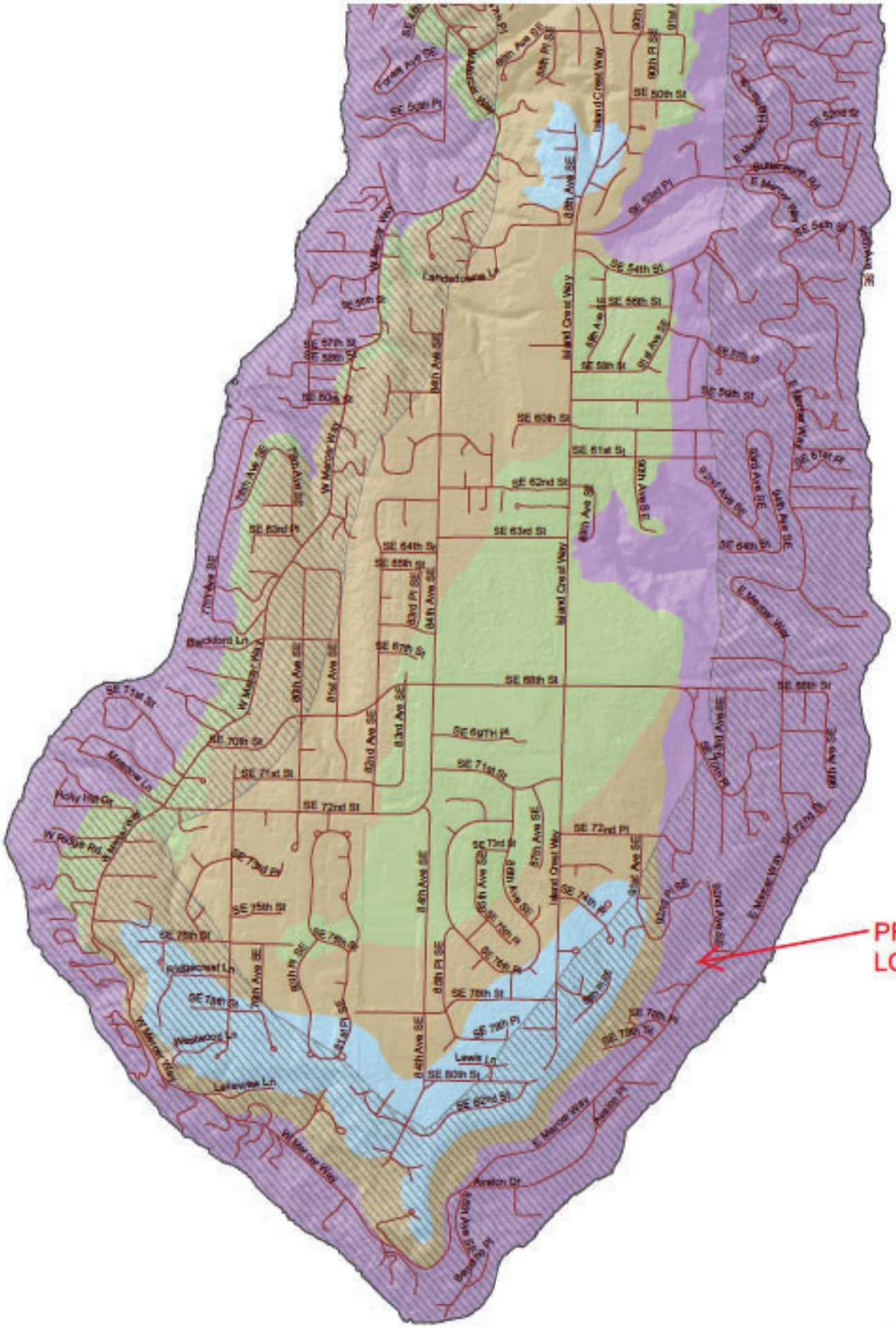
It is the responsibility of the Owner (or their Design Professional) to review site conditions and determine the Kzt factor to be utilized for each specific project. The Kzt factors and wind exposure categories indicated on this map are the minimum values accepted by the City of Mercer Island without requiring the design professional to submit additional calculations and supporting topographic documentation (to verify the values utilized in their wind load determination).

Please note – The Kzt values indicated on this map are approximations based upon periodic calculations of representative samplings around Mercer Island. These values are intended for City of Mercer Island's plan review purposes only.

WIND EXPOSURE CATEGORIES:

WIND SPEED-UP (TOPOGRAPHIC EFFECT) - K_zt Factor :




PROJECT
LOCATION

Summary

The project involves a new custom two-story home with attached garage located on Mercer Island, WA. The footprint is about 74 ft x 50 ft and includes single slope roofs with large overhangs. The framing will consist of conventional wood framing with concrete footings based on a geotech recommendations.

Design Codes

2021 International Building Code
ASCE/SEI 7-22
ACI 318 Concrete 2019
2024 NDS Wood

REV 1

Design Criteria

Roof Snow + 5psf Rain on Snow Load:	30 psf
Wind Speed:	110 mph
Wind Exposure:	C
Seismic Design Category:	D
Seismic Ss:	1.63
Seismic S1:	0.62
Allowable Soil Bearing:	2000 psf

(Earth Solutions NW Geotech Report)

REPORT SUMMARY

Site Information

Address:	*7615 E Mercer Way, Mercer Island, Washington, 98040*
Elevation:	147 ft (NAVD 88)
Lat:	47.534526
Long:	-122.216267
Standard:	ASCE/SEI 7-22
Risk Category:	II
Soil Class:	DE

Seismic Data

S_S	1.63
S_1	0.62
S_{MS}	1.67
S_{M1}	1.61
S_{DS}	1.11
S_{D1}	1.07
T_L	6
PGA_M	0.7
V_{S30}	185
Seismic Design Category	D

Gravity Loads

Roof Dead Loads:	Weight (psf)
Roofing	1.0
Decking	2.0
Roof Joists/Trusses	3.0
Insulation	1.0
Gyp Ceiling	2.5
Mech/Elec	3.5
Misc.	2.0
Total Roof Dead Load	**15.0**

Floor Dead Loads:	Weight (psf)
Flooring	1.5
Gypcrete/overlay (1.5")	0.0
Joists	3.0
Gyp Ceiling	2.5
Mech/Elec	3.5
Misc.	4.5
Total Floor Dead Load	**15.0**

Roof Live Loads:	Weight (psf)
Roof Live Load	20.0
Snow Load + Rain	30.0

Floor Live Loads:	Weight (psf)
Residential	40

Ext. Wall Dead Loads:	Weight (psf)
6" studs	1.8
Sheathing, 15/32"	1.5
Insulation	1.2
Ext finish (siding)	5
Misc	2.5
Total Wall Load	**12**

REV 3

Grade Beam Loading:

Grid 3 & 4 - Worst Case Loading

Tributary	14	ft
Dead	420	lbs
Live	560	lbs
Snow	420	lbs
D+L	980	lbs
D+0.75L+0.75S	1155	lbs
Allowable Pin Pile Capacity	10000	lbs
Maximum pile spacing	8.66	ft

At all bearing lines provide 3" Dia Sch 40 pin piles in two rows at 96" oc staggered (48" nominal spacing). Additional piles to be added at concentrated load points - see plans.

Pile Head Punching Shear Check

ACI Section 22.6 for two way shear

Sec 22.6.5

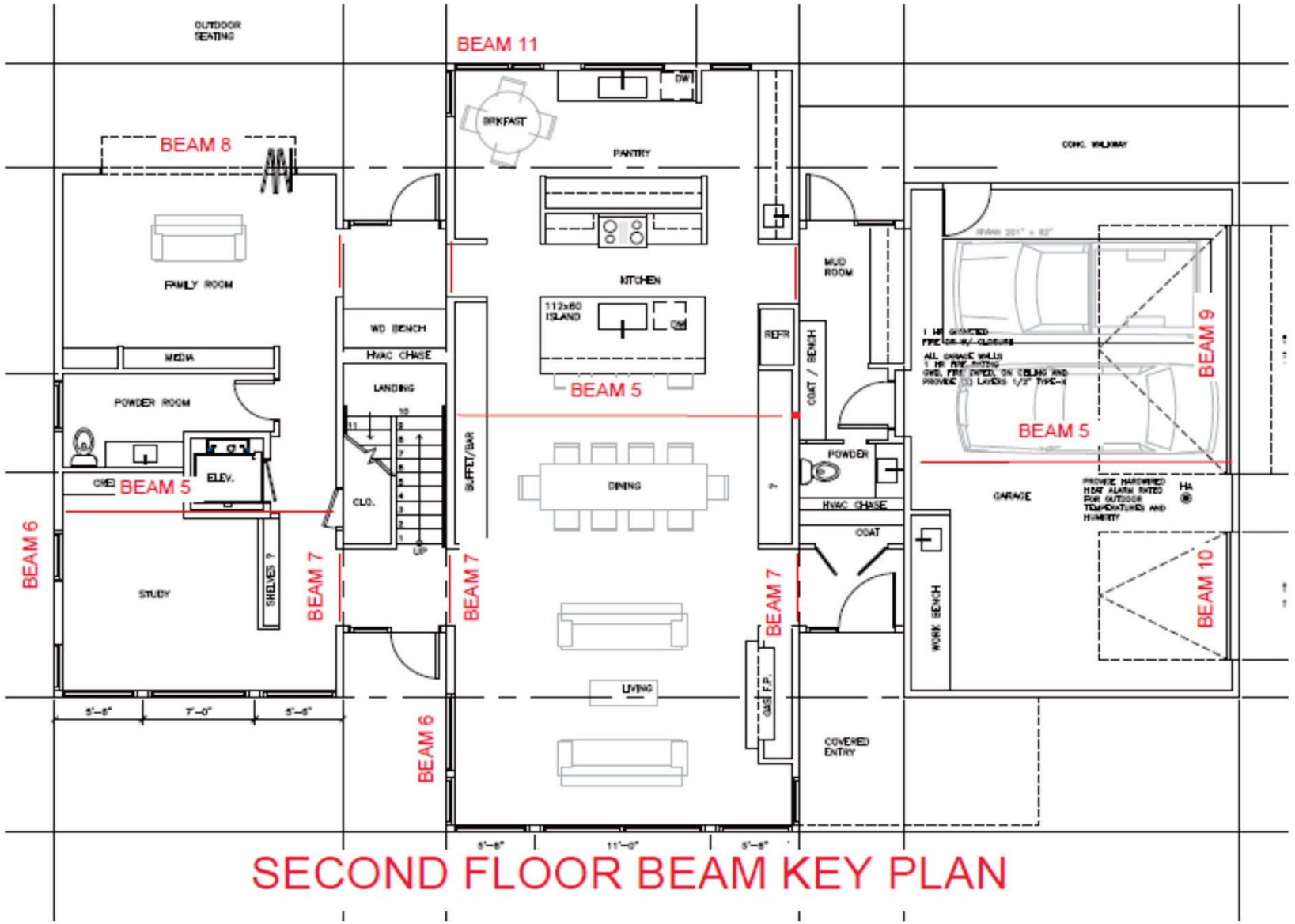
Table 22.6.5.2—Calculation of v_c for two-way shear

v_c		
Least of (a), (b), and (c):	$4\lambda\sqrt{f'_c}$	(a)
	$\left(2+\frac{4}{\beta}\right)\lambda\sqrt{f'_c}$	(b)
	$\left(2+\frac{\alpha_s d}{b_o}\right)\lambda\sqrt{f'_c}$	(c)

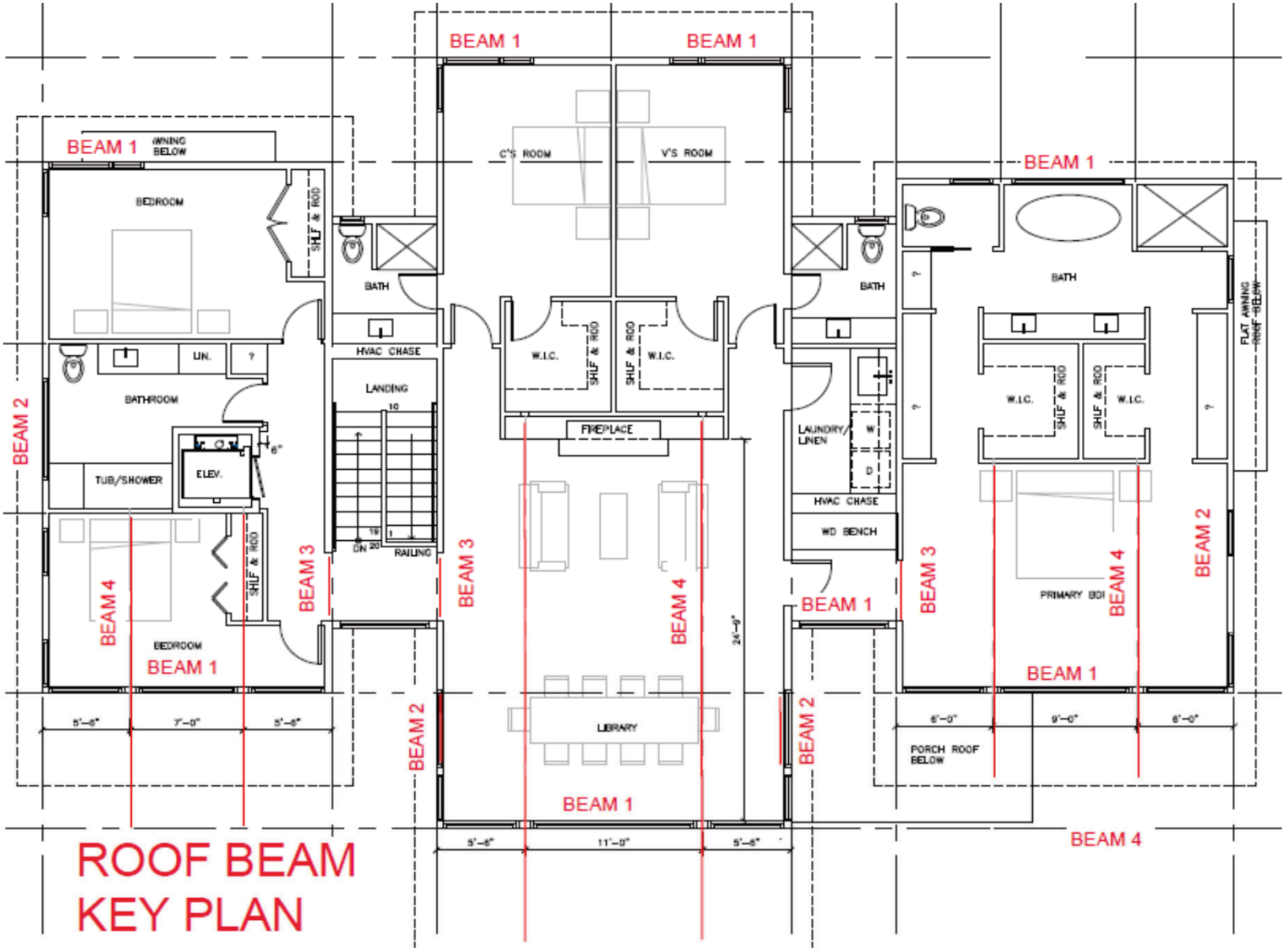
Note: β is the ratio of long side to short side of the column, concentrated load, or reaction area and α_s is given in 22.6.5.3.

F'c	2500 psi	b	15 in
β	1	d	9 in
λ	1	ϕ	0.75
α	20		
Eqn a	81.0 kips		
Eqn b	121.5 kips		
Eqn c	62.8 kips	**PUNCHING SHEAR OK**	

REV 3



SECOND FLOOR BEAM KEY PLAN


BEAM 1
BEAM 1
BEAM 1
AWNING BELOW
BEDROOM
SHLF & ROD
C'S ROOM
V'S ROOM
BEAM 1
BATH
BATH
HVAC CHASE
W.I.C.
SHLF & ROD
SHLF & ROD
W.I.C.
LIN.
BATHROOM
LANDING
FIREPLACE
LAUNDRY/ LINEN
W
D
BATH
W.I.C.
SHLF & ROD
SHLF & ROD
W.I.C.
FLAT AWNING ROOF BELOW
BEAM 2
TUB/SHOWER
ELEV.
HVAC CHASE
WD BENCH
BEAM 3
BEAM 3
BEAM 3
BEAM 4
BEAM 4
BEAM 4
BEAM 2
BEAM 2
RAILING
PRIMARY BDR
BEDROOM
SHLF & ROD
BEAM 1
BEAM 1
BEAM 1
LIBRARY
BEAM 1
PORCH ROOF BELOW
5'-6"
7'-0"
5'-6"
5'-6"
11'-0"
5'-6"
6'-0"
9'-0"
6'-0"
ROOF BEAM
KEY PLAN

Roof & Second Floor Framing Beams

BM #	Description	location	Span	Roof Trib	R DL	Roof S	Roof Live	Floor Trib	FL Live	FL Dead	FL Live	Beam Size
			ft	ft	PLF	PLF	PLF	ft	PSF	PLF	PLF	
BM 1	Rf Ext Non Brg Hdr	Roof	6	2	30	60	40	0	0	0	0	(2) 2x10 DFL #2
Bm 2	Rf Ext Brg Hdr	Roof	7	12	180	360	240	0	0	0	0	(2) 2x10 DFL #2
BM 3	Int Brg Hdr	Roof	5	14.5	217.5	435	290	0	0	0	0	(2) 2x10 DFL #2
BM 4	Roof Girders	Roof	27	8.5	127.5	255	170		40	0	0	GL 6.75x24
BM 5	Second Flr Tfr Bms	2nd Floor	22	Conc	1.7k	3.3k	2.2k	1.33	40	20	53	GL 6.75x15
BM 6	Ext Brg Hdr	2nd Floor	6	9	135	270	180	9	40	135	360	(2) 2x10 DFL #2
BM 7	Int Brg Hdr	2nd Floor	6	14	210	420	280	14	40	210	560	(2) 2x10 DFL #2
BM 8	Folding Door hdr	2nd Floor	12	2	30	60	40	2	40	30	80	GL 5.5x10.5
BM 9	Large Gar Hdr	2nd Floor	16.5	12	180	360	240	10.5	40	158	420	GL 5.5x13.5
BM 10	Short Gar Hdr	2nd Floor	8.5	12	180	360	240	10.5	40	158	420	GL 5.5x9
BM 11	Ext Non Brg Hdr	2nd Floor	5	5	75	150	100	5	40	75	200	(2) 2x10 DFL #2

			BM Reaction (left)				BM Reaction (right)					Ftg Size (2000psf)
BM #	Description	location	DL	FL LL	Snow	Total	DL	FL LL	Snow	Total	Post Size	(ft)
			k	k	k	k	k	k	k	k		
BM 1	Rf Ext Non Brg Hdr	Roof	0.5	0.0	0.5	1.0	0.5	0.0	0.5	1.0	(2) studs	0.7
Bm 2	Rf Ext Brg Hdr	Roof	0.6		1.3	1.9	0.6	0.0	1.3	1.9	(2) studs	1.0
BM 3	Int Brg Hdr	Roof	0.5		1.1	1.6	0.5	0.0	1.1	1.6	(2) studs	0.9
BM 4	Roof Girders	Roof	1.7		3.3	5.0	3.0		6.1	9.1	(3) studs	1.3
BM 5	Second Flr Tfr Bms	2nd Floor	1.7		3.3	5.0	1.7	0.0	3.3	5.0	(2) studs	1.3
BM 6	Ext Brg Hdr	2nd Floor	0.4	1.0	0.8	1.8	0.4	1.0	0.8	1.8	(2) studs	0.9
BM 7	Int Brg Hdr	2nd Floor	0.5	1.7	1.3	2.8	0.5	2.0	1.3	2.8	(2) studs	1.2
BM 8	Folding Door hdr	2nd Floor	0.2	1.0	0.4	1.3	0.2	2.0	0.4	1.3	(2) studs	0.8
BM 9	Large Gar Hdr	2nd Floor	2.8	3.5	3.0	7.7	2.8	2.0	3.0	7.7	(2) studs	1.3
BM 10	Short Gar Hdr	2nd Floor	1.5	1.8	1.5	4.0	1.5	3.0	1.5	4.0	(2) studs	1.3
BM 11	Ext Non Brg Hdr	2nd Floor	0.4	0.5	0.4	1.1	0.4	3.0	0.4	1.1	(2) studs	0.7

NOTES:
1. SEE ENERCALC OUTPUT SHEETS FOR BEAM DESIGNS
2. TOTAL LOAD INCLUDES LOAD CASES D+L, D=0.75*L+0.75*S

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 1 Rf non brg hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

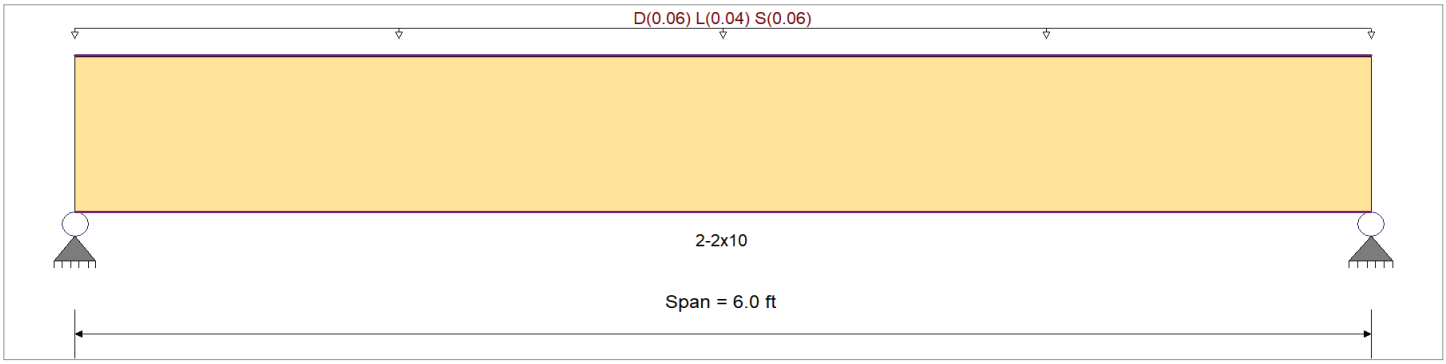
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Uniform Load : D = 0.030, L = 0.020, S = 0.030 ksf, Tributary Width = 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.156 : 1	Maximum Shear Stress Ratio	=	0.082 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	177.99 psi	fv: Actual	=	17.03 psi
F'b	=	1,138.50 psi	F'v	=	207.00 psi
Load Combination		+D+0.750L+0.750S	Load Combination		+D+0.750L+0.750S
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.006 in	Ratio =	12952	>=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0	<360	n/a
Max Downward Total Deflection	0.013 in	Ratio =	5511	>=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0	<240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.094	0.049	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.30	83.3	891.0	0.15	8.0	162.0
+D+L					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.135	0.071	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.48	133.8	990.0	0.24	12.8	180.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.140	0.073	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.57	159.1	1,138.5	0.28	15.2	207.0
+D+0.750L					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.098	0.052	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.43	121.2	1,237.5	0.21	11.6	225.0
+D+0.750L+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.156	0.082	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.63	178.0	1,138.5	0.31	17.0	207.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 1 Rf non brg hdr

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.032	0.017	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.18	50.0	1,584.0	0.09	4.8	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0131	3.022		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.423	0.423
Max Upward from Load Combinations	0.423	0.423
Max Upward from Load Cases	0.198	0.198
D Only	0.198	0.198
+D+L	0.318	0.318
+D+S	0.378	0.378
+D+0.750L	0.288	0.288
+D+0.750L+0.750S	0.423	0.423
+0.60D	0.119	0.119
L Only	0.120	0.120
S Only	0.180	0.180

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 2 Roof Ext Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

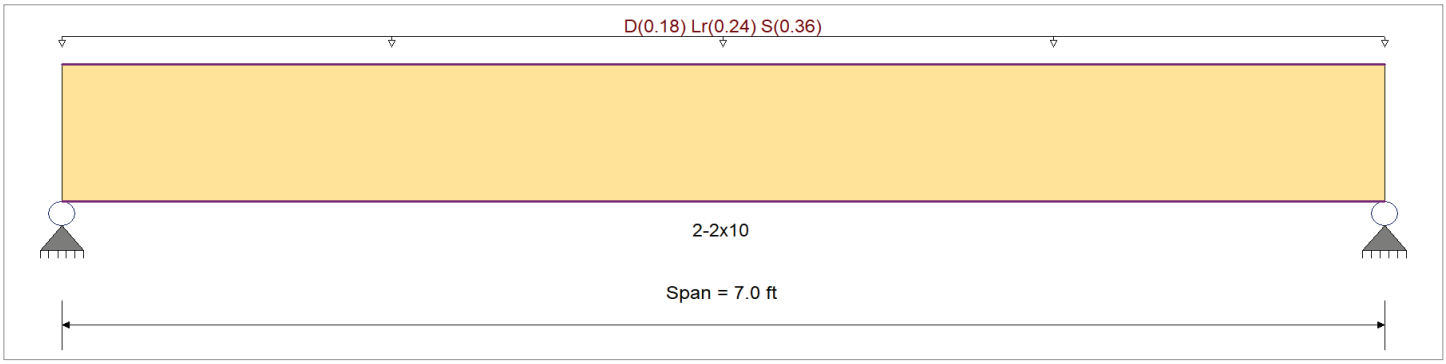
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, Lr = 0.020, S = 0.030 ksf, Tributary Width = 12.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.815 : 1	Maximum Shear Stress Ratio	=	0.385 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	927.74 psi	fv: Actual	=	79.79 psi
F'b	=	1,138.50 psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	3.500 ft	Location of maximum on span	=	6.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.062 in	Ratio =	1359 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.093 in	Ratio =	906 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.347	0.164	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.10	309.2	891.0	0.49	26.6	162.0
+D+Lr					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.583	0.276	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.57	721.6	1,237.5	1.15	62.1	225.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.815	0.385	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	3.31	927.7	1,138.5	1.48	79.8	207.0
+D+0.750Lr					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.500	0.236	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.21	618.5	1,237.5	0.98	53.2	225.0
+D+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.679	0.321	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.76	773.1	1,138.5	1.23	66.5	207.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 2 Roof Ext Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1	0.117	0.055	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.66	185.5	1,584.0	0.30	16.0	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0927	3.526		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.890	1.890
Max Upward from Load Combinations	1.890	1.890
Max Upward from Load Cases	1.260	1.260
D Only	0.630	0.630
+D+Lr	1.470	1.470
+D+S	1.890	1.890
+D+0.750Lr	1.260	1.260
+D+0.750S	1.575	1.575
+0.60D	0.378	0.378
Lr Only	0.840	0.840
S Only	1.260	1.260

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 3 Int Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

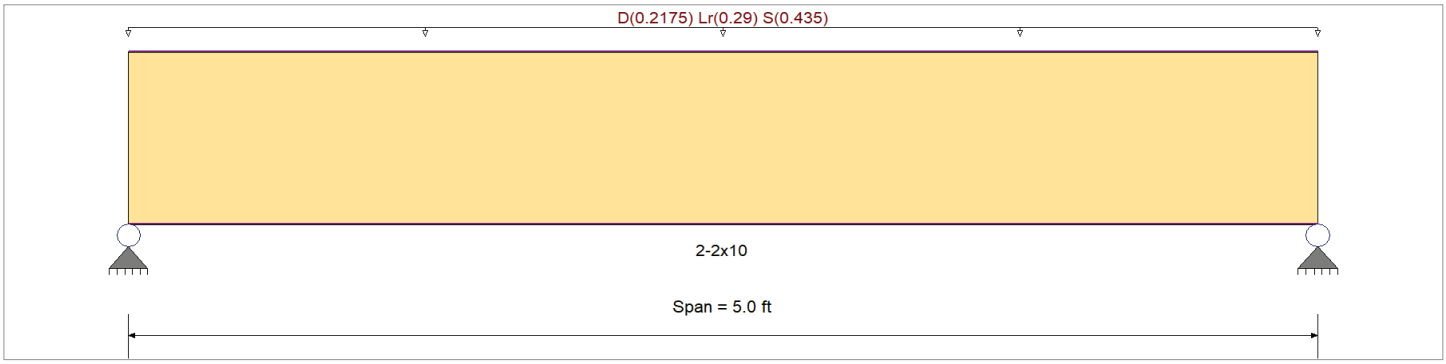
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, Lr = 0.020, S = 0.030 ksf, Tributary Width = 14.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.502 : 1	Maximum Shear Stress Ratio	=	0.295 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	571.95 psi	fv: Actual	=	61.14 psi
F'b	=	1,138.50 psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	2.500 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.019 in	Ratio =	3087 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.029 in	Ratio =	2058 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.214	0.126	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.68	190.7	891.0	0.38	20.4	162.0
+D+Lr					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.359	0.211	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.59	444.9	1,237.5	0.88	47.6	225.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.502	0.295	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.04	572.0	1,138.5	1.13	61.1	207.0
+D+0.750Lr					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.308	0.181	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.36	381.3	1,237.5	0.75	40.8	225.0
+D+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.419	0.246	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.70	476.6	1,138.5	0.94	51.0	207.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 3 Int Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.072	0.042	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.41	114.4	1,584.0	0.23	12.2	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0292	2.518		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.631	1.631
Max Upward from Load Combinations	1.631	1.631
Max Upward from Load Cases	1.088	1.088
D Only	0.544	0.544
+D+Lr	1.269	1.269
+D+S	1.631	1.631
+D+0.750Lr	1.088	1.088
+D+0.750S	1.359	1.359
+0.60D	0.326	0.326
Lr Only	0.725	0.725
S Only	1.088	1.088

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 4 Roof Grdrs

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

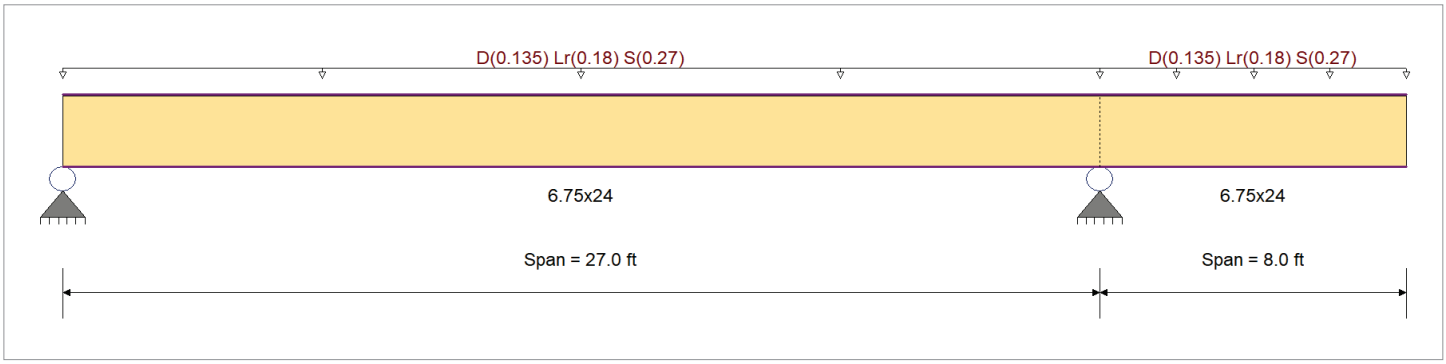
Wood Species : DF/DF
Wood Grade : 24F-V8

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	2,400.0 psi
Fb -	2,400.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : D = 0.0150, Lr = 0.020, S = 0.030 ksf, Tributary Width = 9.0 ft
Load for Span Number 2
Uniform Load : D = 0.0150, Lr = 0.020, S = 0.030 ksf, Tributary Width = 9.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.233 : 1	Maximum Shear Stress Ratio	=	0.157 : 1
Section used for this span		6.75x24	Section used for this span		6.75x24
fb: Actual	=	568.69 psi	fv: Actual	=	47.72 psi
F'b	=	2,443.04 psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	12.369 ft	Location of maximum on span	=	25.039 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.184 in	Ratio =	1760 >=360	Span: 1 : S Only
Max Upward Transient Deflection	-0.125 in	Ratio =	1536 >=360	Span: 2 : S Only
Max Downward Total Deflection	0.276 in	Ratio =	1173 >=240	Span: 1 : +D+S
Max Upward Total Deflection	-0.187 in	Ratio =	1024 >=240	Span: 2 : +D+S

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 27.0 ft	1	0.099	0.067	0.90	1.00	1.00	1.00	0.885	1.00	1.00	1.00	10.24	189.6	1,911.9	1.72	15.9	238.5
Length = 8.0 ft	2	0.037	0.067	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	4.32	80.0	2,159.2	0.81	15.9	238.5
+D+Lr					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 27.0 ft	1	0.167	0.112	1.25	1.00	1.00	1.00	0.885	1.00	1.00	1.00	23.89	442.3	2,655.5	4.01	37.1	331.3
Length = 8.0 ft	2	0.062	0.112	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	10.08	186.7	2,999.0	1.90	37.1	331.3
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 27.0 ft	1	0.233	0.157	1.15	1.00	1.00	1.00	0.885	1.00	1.00	1.00	30.71	568.7	2,443.0	5.15	47.7	304.8

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 4 Roof Grdrs

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
Length = 8.0 ft	**2**	0.087	0.157	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	12.96	240.0	2,759.0	2.44	47.7	304.8
+D+0.750Lr					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 27.0 ft	**1**	0.143	0.096	1.25	1.00	1.00	1.00	0.885	1.00	1.00	1.00	20.47	379.1	2,655.5	3.44	31.8	331.3
Length = 8.0 ft	**2**	0.053	0.096	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	8.64	160.0	2,999.0	1.63	31.8	331.3
+D+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 27.0 ft	**1**	0.194	0.130	1.15	1.00	1.00	1.00	0.885	1.00	1.00	1.00	25.59	473.9	2,443.0	4.29	39.8	304.8
Length = 8.0 ft	**2**	0.072	0.130	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	10.80	200.0	2,759.0	2.04	39.8	304.8
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 27.0 ft	**1**	0.033	0.023	1.60	1.00	1.00	1.00	0.885	1.00	1.00	1.00	6.14	113.7	3,399.0	1.03	9.5	424.0
Length = 8.0 ft	**2**	0.013	0.023	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.59	48.0	3,838.7	0.49	9.5	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.2761	13.123		0.0000	0.000
	2	0.0000	13.123	+D+S	-0.1873	8.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Max Upward from all Load Conditions	4.988	9.188	
Max Upward from Load Combinations	4.988	9.188	
Max Upward from Load Cases	3.325	6.125	
D Only	1.663	3.063	
+D+Lr	3.879	7.146	
+D+S	4.988	9.188	
+D+0.750Lr	3.325	6.125	
+D+0.750S	4.156	7.656	
+0.60D	0.998	1.838	
Lr Only	2.217	4.083	
S Only	3.325	6.125	

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 5 2nd Flr Tfr Bms

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

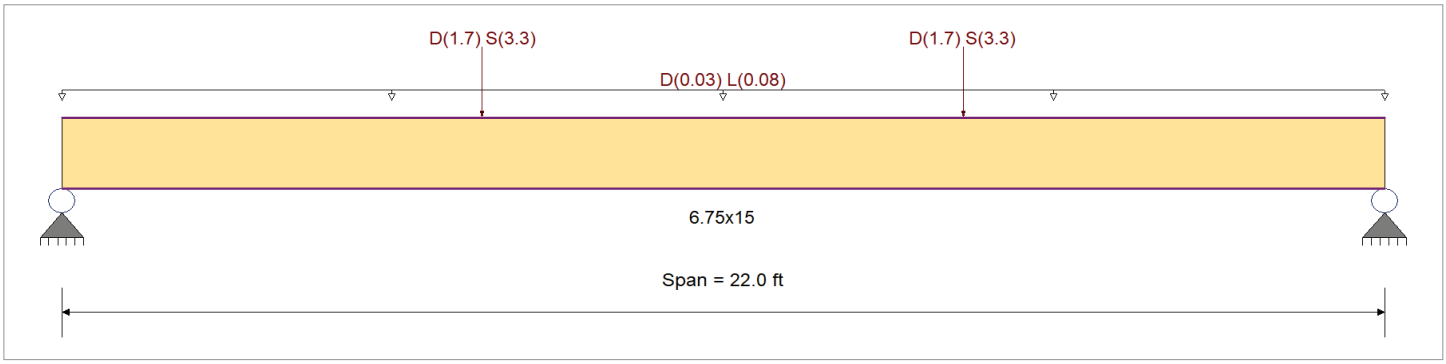
Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Point Load : D = 1.70, S = 3.30 k @ 7.0 ft
Point Load : D = 1.70, S = 3.30 k @ 15.0 ft
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.668 : 1	Maximum Shear Stress Ratio	=	0.257 : 1
Section used for this span		6.75x15	Section used for this span		6.75x15
fb: Actual	=	1,745.30 psi	fv: Actual	=	78.43 psi
F'b	=	2,613.59 psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	11.000 ft	Location of maximum on span	=	20.796 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.615 in	Ratio =	429 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.978 in	Ratio =	269 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 22.0 ft	1	0.318	0.124	0.90	1.00	1.00	1.00	0.947	1.00	1.00	1.00	13.72	650.2	2,045.4	1.99	29.5	238.5
+D+L					1.00	1.00	1.00	0.947	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 22.0 ft	1	0.387	0.155	1.00	1.00	1.00	1.00	0.947	1.00	1.00	1.00	18.56	879.6	2,272.7	2.78	41.1	265.0
+D+S					1.00	1.00	1.00	0.947	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 22.0 ft	1	0.668	0.257	1.15	1.00	1.00	1.00	0.947	1.00	1.00	1.00	36.82	1,745.3	2,613.6	5.29	78.4	304.8
+D+0.750L					1.00	1.00	1.00	0.947	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 22.0 ft	1	0.289	0.115	1.25	1.00	1.00	1.00	0.947	1.00	1.00	1.00	17.35	822.3	2,840.9	2.58	38.2	331.3
+D+0.750L+0.750S					1.00	1.00	1.00	0.947	1.00	1.00	1.00			0.0	0.00	0.0	0.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 5 2nd Flr Tfr Bms

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
Length = 22.0 ft	1	0.629	0.246	1.15	1.00	1.00	1.00	0.947	1.00	1.00	1.00	34.67	1,643.6	2,613.6	5.06	74.9	304.8
+0.60D					1.00	1.00	1.00	0.947	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 22.0 ft	1	0.107	0.042	1.60	1.00	1.00	1.00	0.947	1.00	1.00	1.00	8.23	390.1	3,636.3	1.20	17.7	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.9781	11.080		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	5.330	5.330
Max Upward from Load Combinations	5.330	5.330
Max Upward from Load Cases	3.300	3.300
D Only	2.030	2.030
+D+L	2.910	2.910
+D+S	5.330	5.330
+D+0.750L	2.690	2.690
+D+0.750L+0.750S	5.165	5.165
+0.60D	1.218	1.218
L Only	0.880	0.880
S Only	3.300	3.300

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 6 Ext Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

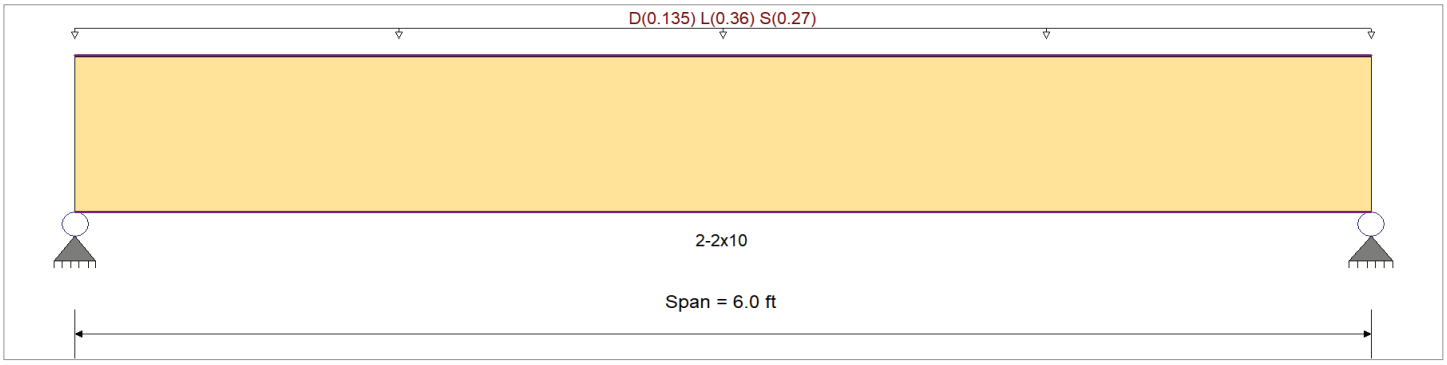
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, L = 0.040, S = 0.030 ksf, Tributary Width = 9.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.674 : 1	Maximum Shear Stress Ratio	=	0.354 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	766.81 psi	fv: Actual	=	73.35 psi
F'b	=	1,138.50 psi	F'v	=	207.00 psi
Load Combination		+D+0.750L+0.750S	Load Combination		+D+0.750L+0.750S
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.033 in	Ratio =	2158 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.056 in	Ratio =	1279 >=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.191	0.101	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.61	170.4	891.0	0.30	16.3	162.0
+D+L					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.631	0.332	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.23	624.8	990.0	1.11	59.8	180.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.449	0.236	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.82	511.2	1,138.5	0.90	48.9	207.0
+D+0.750L					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.413	0.217	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.82	511.2	1,237.5	0.90	48.9	225.0
+D+0.750L+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.674	0.354	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.73	766.8	1,138.5	1.36	73.3	207.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 6 Ext Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.065	0.034	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.36	102.2	1,584.0	0.18	9.8	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0563	3.022		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.823	1.823
Max Upward from Load Combinations	1.823	1.823
Max Upward from Load Cases	1.080	1.080
D Only	0.405	0.405
+D+L	1.485	1.485
+D+S	1.215	1.215
+D+0.750L	1.215	1.215
+D+0.750L+0.750S	1.823	1.823
+0.60D	0.243	0.243
L Only	1.080	1.080
S Only	0.810	0.810

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 7 Int Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

Wood Species : Douglas Fir-Larch
Wood Grade : No.2

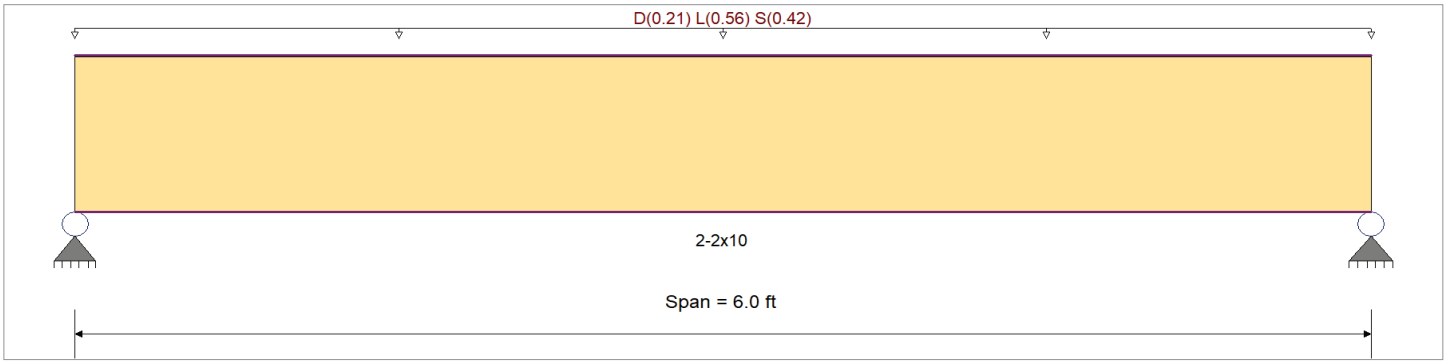
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, L = 0.040, S = 0.030 ksf, Tributary Width = 14.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.911 : 1	Maximum Shear Stress Ratio	=	0.551 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	1,192.81 psi	fv: Actual	=	114.09 psi
F'b	=	1,309.28 psi	F'v	=	207.00 psi
Load Combination		+D+0.750L+0.750S	Load Combination		+D+0.750L+0.750S
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.052 in	Ratio =	1387 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.088 in	Ratio =	822 >=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.259	0.157	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.95	265.1	1,024.7	0.47	25.4	162.0
+D+L					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.854	0.516	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.15	3.47	971.9	1,138.5	1.72	93.0	180.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.607	0.367	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.15	2.84	795.2	1,309.3	1.41	76.1	207.0
+D+0.750L					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.559	0.338	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.15	2.84	795.2	1,423.1	1.41	76.1	225.0
+D+0.750L+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 6.0 ft	1	0.911	0.551	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.15	4.25	1,192.8	1,309.3	2.11	114.1	207.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 7 Int Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 6.0 ft	**1**	0.087	0.053	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.57	159.0	1,821.6	0.28	15.2	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0876	3.022		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	2.835	2.835
Max Upward from Load Combinations	2.835	2.835
Max Upward from Load Cases	1.680	1.680
D Only	0.630	0.630
+D+L	2.310	2.310
+D+S	1.890	1.890
+D+0.750L	1.890	1.890
+D+0.750L+0.750S	2.835	2.835
+0.60D	0.378	0.378
L Only	1.680	1.680
S Only	1.260	1.260

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 8 Folding Door

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

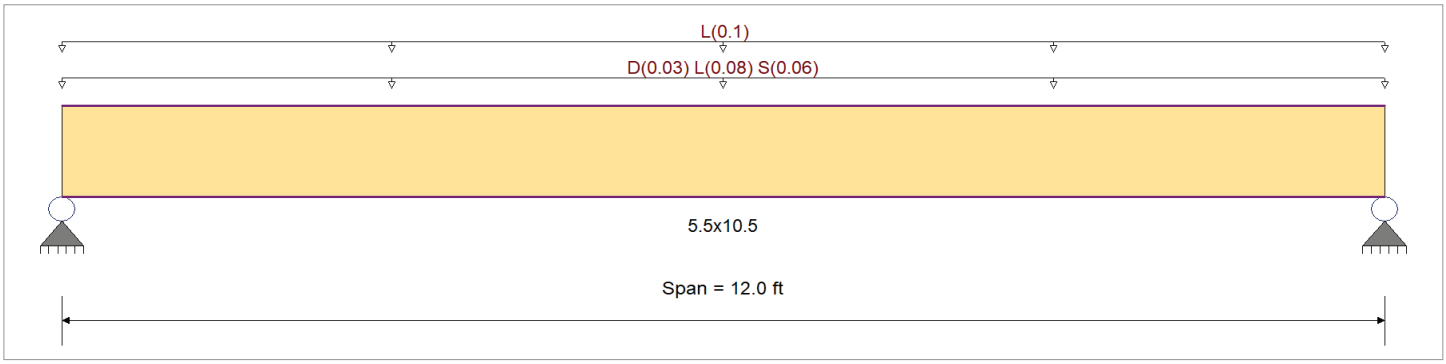
Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	2400 psi
Fb -	1850 psi
Fc - Prll	1650 psi
Fc - Perp	650 psi
Fv	265 psi
Ft	1100 psi

E : Modulus of Elasticity

Ebend- xx	1800 ksi
Eminbend - xx	950 ksi
Ebend- yy	1600 ksi
Eminbend - yy	850 ksi
Density	31.21 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, L = 0.040, S = 0.030 ksf, Tributary Width = 2.0 ft
Uniform Load : L = 0.10 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.187 : 1	Maximum Shear Stress Ratio	=	0.106 : 1
Section used for this span		5.5x10.5	Section used for this span		5.5x10.5
fb: Actual	=	448.83 psi	fv: Actual	=	28.19 psi
F'b	=	2,400.00 psi	F'v	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.088 in	Ratio =	1628	>=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<360	n/a
Max Downward Total Deflection	0.103 in	Ratio =	1395	>=240	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.030	0.017	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	0.54	64.1	2,160.0	0.16	4.0	238.5
+D+L					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.187	0.106	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	3.78	448.8	2,400.0	1.09	28.2	265.0
+D+S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.070	0.040	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.62	192.4	2,760.0	0.47	12.1	304.8
+D+0.750L					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.118	0.067	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.97	352.7	3,000.0	0.85	22.1	331.3
+D+0.750L+0.750S					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 8 Folding Door

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
Length = 12.0 ft	1	0.163	0.092	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	3.78	448.8	2,760.0	1.09	28.2	304.8
+0.60D					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 12.0 ft	1	0.010	0.006	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	0.32	38.5	3,840.0	0.09	2.4	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.1032	6.044		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.260	1.260
Max Upward from Load Combinations	1.260	1.260
Max Upward from Load Cases	1.080	1.080
D Only	0.180	0.180
+D+L	1.260	1.260
+D+S	0.540	0.540
+D+0.750L	0.990	0.990
+D+0.750L+0.750S	1.260	1.260
+0.60D	0.108	0.108
L Only	1.080	1.080
S Only	0.360	0.360

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 9 Large Gar Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

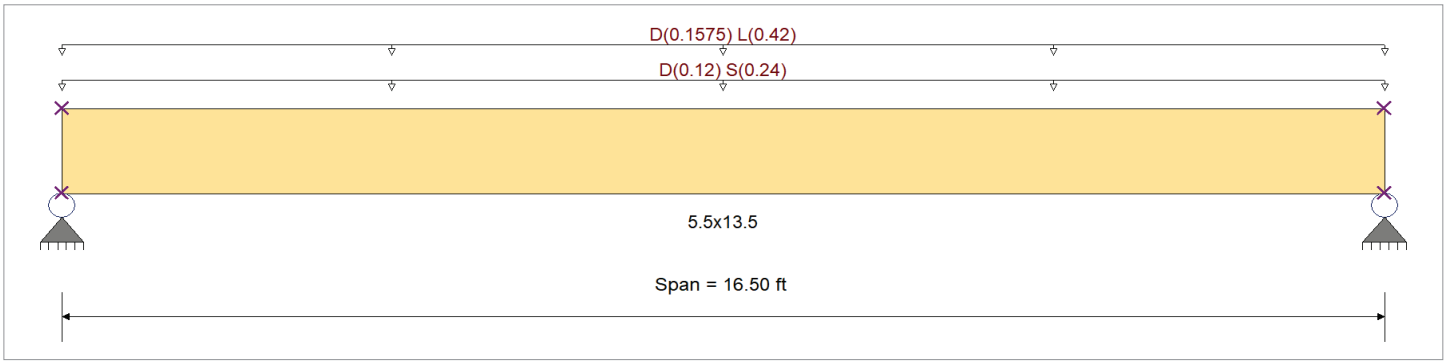
Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, S = 0.030 ksf, Tributary Width = 8.0 ft
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 10.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.723 : 1	Maximum Shear Stress Ratio	=	0.381 : 1
Section used for this span		5.5x13.5	Section used for this span		5.5x13.5
fb: Actual	=	1,705.00 psi	fv: Actual	=	100.98 psi
F'b	=	2,358.71 psi	F'v	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	8.250 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.347 in	Ratio =	570 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.638 in	Ratio =	310 >=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 16.50 ft	1	0.319	0.168	0.90	1.00	1.00	0.98	1.000	1.00	1.00	1.00	9.44	678.3	2,127.5	1.99	40.2	238.5
+D+L					1.00	1.00	0.98	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 16.50 ft	1	0.723	0.381	1.00	1.00	1.00	0.98	1.000	1.00	1.00	1.00	23.74	1,705.0	2,358.7	5.00	101.0	265.0
+D+S					1.00	1.00	0.98	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 16.50 ft	1	0.468	0.246	1.15	1.00	1.00	0.98	1.000	1.00	1.00	1.00	17.61	1,265.0	2,702.9	3.71	74.9	304.8
+D+0.750L					1.00	1.00	0.98	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 16.50 ft	1	0.494	0.259	1.25	1.00	1.00	0.98	1.000	1.00	1.00	1.00	20.16	1,448.3	2,930.4	4.25	85.8	331.3
+D+0.750L+0.750S					1.00	1.00	0.98	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 9 Large Gar Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
Length = 16.50 ft	1	0.699	0.367	1.15	1.00	1.00	0.98	1.000	1.00	1.00	1.00	26.29	1,888.3	2,702.9	5.54	111.8	304.8
+0.60D					1.00	1.00	0.98	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 16.50 ft	1	0.110	0.057	1.60	1.00	1.00	0.97	1.000	1.00	1.00	1.00	5.67	407.0	3,712.0	1.19	24.1	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.6384	8.310		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	6.373	6.373
Max Upward from Load Combinations	6.373	6.373
Max Upward from Load Cases	3.465	3.465
D Only	2.289	2.289
+D+L	5.754	5.754
+D+S	4.269	4.269
+D+0.750L	4.888	4.888
+D+0.750L+0.750S	6.373	6.373
+0.60D	1.374	1.374
L Only	3.465	3.465
S Only	1.980	1.980

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 10 Short Gar Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

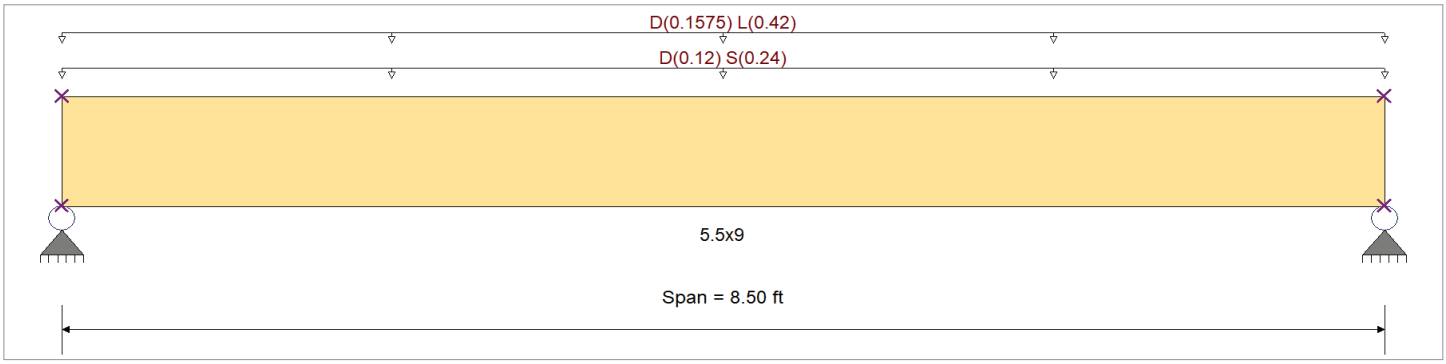
Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, S = 0.030 ksf, Tributary Width = 8.0 ft
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 10.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.426 : 1	Maximum Shear Stress Ratio	=	0.280 : 1
Section used for this span		5.5x9	Section used for this span		5.5x9
fb: Actual	=	1,018.07 psi	fv: Actual	=	74.09 psi
F'b	=	2,387.78 psi	F'v	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.250 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.083 in	Ratio =	1236 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.152 in	Ratio =	672 >=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.188	0.124	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.51	405.0	2,150.2	0.97	29.5	238.5
+D+L					1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.426	0.280	1.00	1.00	1.00	0.99	1.000	1.00	1.00	1.00	6.30	1,018.1	2,387.8	2.45	74.1	265.0
+D+S					1.00	1.00	0.99	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.275	0.180	1.15	1.00	1.00	0.99	1.000	1.00	1.00	1.00	4.67	755.3	2,743.6	1.81	55.0	304.8
+D+0.750L					1.00	1.00	0.99	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.290	0.190	1.25	1.00	1.00	0.99	1.000	1.00	1.00	1.00	5.35	864.8	2,980.5	2.08	62.9	331.3
+D+0.750L+0.750S					1.00	1.00	0.99	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 10 Short Gar Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_V	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
Length = 8.50 ft	1	0.411	0.269	1.15	1.00	1.00	0.99	1.000	1.00	1.00	1.00	6.98	1,127.5	2,743.6	2.71	82.1	304.8
+0.60D					1.00	1.00	0.99	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.064	0.042	1.60	1.00	1.00	0.99	1.000	1.00	1.00	1.00	1.50	243.0	3,806.9	0.58	17.7	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.1517	4.281		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	3.283	3.283
Max Upward from Load Combinations	3.283	3.283
Max Upward from Load Cases	1.785	1.785
D Only	1.179	1.179
+D+L	2.964	2.964
+D+S	2.199	2.199
+D+0.750L	2.518	2.518
+D+0.750L+0.750S	3.283	3.283
+0.60D	0.708	0.708
L Only	1.785	1.785
S Only	1.020	1.020

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 11 Ext Non Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2021

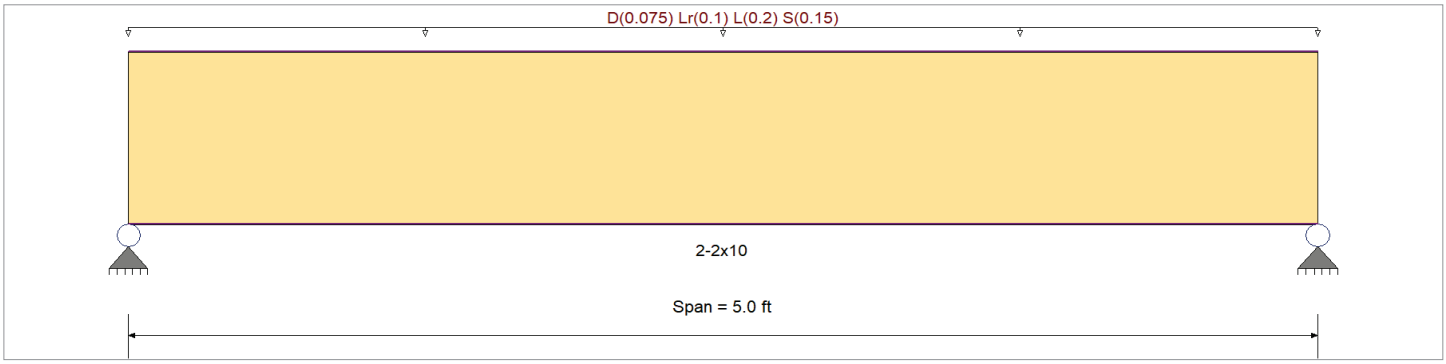
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.210 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, Lr = 0.020, L = 0.040, S = 0.030 ksf, Tributary Width = 5.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.260 : 1	Maximum Shear Stress Ratio	=	0.153 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	295.84 psi	fv: Actual	=	31.63 psi
F'b	=	1,138.50 psi	F'v	=	207.00 psi
Load Combination		+D+0.750L+0.750S	Load Combination		+D+0.750L+0.750S
Location of maximum on span	=	2.500 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.009 in	Ratio =	6714	>=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<360	n/a
Max Downward Total Deflection	0.015 in	Ratio =	3978	>=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0	<240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.074	0.043	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.23	65.7	891.0	0.13	7.0	162.0
+D+L					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.243	0.143	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.86	241.1	990.0	0.48	25.8	180.0
+D+Lr					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.124	0.073	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.55	153.4	1,237.5	0.30	16.4	225.0
+D+S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.173	0.102	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.70	197.2	1,138.5	0.39	21.1	207.0
+D+0.750Lr+0.750L					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.212	0.125	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.94	263.0	1,237.5	0.52	28.1	225.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Beam 11 Ext Non Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	Moment Values M	fb	F'b	Shear Values V	fv	F'v
+D+0.750L+0.750S					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.260	0.153	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.05	295.8	1,138.5	0.59	31.6	207.0
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1	0.025	0.015	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.14	39.4	1,584.0	0.08	4.2	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0151	2.518		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.844	0.844
Max Upward from Load Combinations	0.844	0.844
Max Upward from Load Cases	0.500	0.500
D Only	0.188	0.188
+D+L	0.688	0.688
+D+Lr	0.438	0.438
+D+S	0.563	0.563
+D+0.750Lr+0.750L	0.750	0.750
+D+0.750L+0.750S	0.844	0.844
+0.60D	0.113	0.113
Lr Only	0.250	0.250
L Only	0.500	0.500
S Only	0.375	0.375

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

General Footing

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Roof Girder Footings

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,122.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.000180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	2.0	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

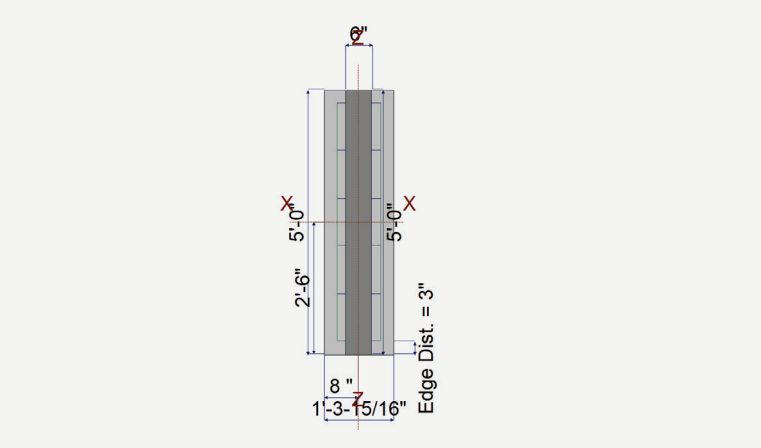
Width parallel to X-X Axis	=	1.330 ft
Length parallel to Z-Z Axis	=	5.0 ft
Footing Thickness	=	12.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	6.0 in
pz : parallel to Z-Z Axis	=	60.0 in
Height	=	12.0 in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in



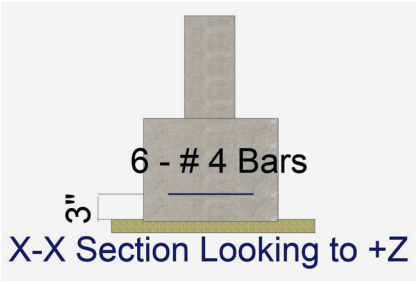
Reinforcing

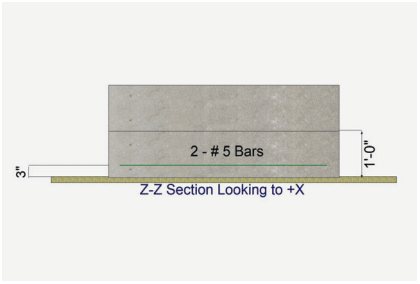
Bars parallel to X-X Axis			
Number of Bars	=		6
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		2
Reinforcing Bar Size	=	#	5

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation

	Bars along X-X Axis
# Bars required within zone	42.0 %
# Bars required on each side of zone	58.0 %





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	3.0			6.10				k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

DESCRIPTION: Roof Girder Footings

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.7565	Soil Bearing	1.513 ksf	2.0 ksf	+D+S about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.01837	Z Flexure (+X)	0.1730 k-ft/ft	9.415 k-ft/ft	+1.20D+1.60S
PASS	0.01837	Z Flexure (-X)	0.1730 k-ft/ft	9.415 k-ft/ft	+1.20D+1.60S
PASS	0.0	X Flexure (+Z)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	0.0	X Flexure (-Z)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	n/a	1-way Shear (+X)	0.0 psi	75.0 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a
PASS	n/a	1-way Shear (+Z)	0.0 psi	75.0 psi	n/a
PASS	n/a	1-way Shear (-Z)	0.0 psi	75.0 psi	n/a
PASS	n/a	2-way Punching	0.0 psi	75.0 psi	+1.40D

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	2.0	n/a	0.0	0.5961	0.5961	n/a	n/a	0.298
X-X, +D+S	2.0	n/a	0.0	1.513	1.513	n/a	n/a	0.757
X-X, +D+0.750S	2.0	n/a	0.0	1.284	1.284	n/a	n/a	0.642
X-X, +0.60D	2.0	n/a	0.0	0.3577	0.3577	n/a	n/a	0.179
Z-Z, D Only	2.0	0.0	n/a	n/a	n/a	0.5961	0.5961	0.298
Z-Z, +D+S	2.0	0.0	n/a	n/a	n/a	1.513	1.513	0.757
Z-Z, +D+0.750S	2.0	0.0	n/a	n/a	n/a	1.284	1.284	0.642
Z-Z, +0.60D	2.0	0.0	n/a	n/a	n/a	0.3577	0.3577	0.179

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.40D	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.50S	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.50S	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+1.60S	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+1.60S	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.70S	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.70S	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +0.90D	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +0.90D	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
Z-Z, +1.40D	0.05439	-X	Bottom	0.02592	AsMin	0.240	9.415	OK

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

General Footing

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30 Merrell Design Services PLLC (c) ENERCALC INC 1983-2023

DESCRIPTION: Roof Girder Footings

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.40D	0.05439	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D	0.04662	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D	0.04662	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.50S	0.08611	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.50S	0.08611	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+1.60S	0.1730	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+1.60S	0.1730	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.70S	0.1019	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.70S	0.1019	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +0.90D	0.03496	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +0.90D	0.03496	+X	Bottom	0.02592	AsMin	0.240	9.415	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D+0.50S	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D+1.60S	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D+0.70S	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+0.90D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	90.00 psi	0	OK
+1.20D	0.00 psi	90.00 psi	0	OK
+1.20D+0.50S	0.00 psi	90.00 psi	0	OK
+1.20D+1.60S	0.00 psi	90.00 psi	0	OK
+1.20D+0.70S	0.00 psi	90.00 psi	0	OK
+0.90D	0.00 psi	90.00 psi	0	OK

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wall Footing

Project File: cheshire framing 20241204.ec6

DESCRIPTION: TYPICAL STRIP FOOTINGS (INTERIOR & EXTERIOR)

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.000140
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
AutoCalc Footing Weight as DL :		Yes

Soil Design Values

Allowable Soil Bearing	=	2.0 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Reference Depth below Surface	=	ft
Allow. Pressure Increase per foot of depth	=	ksf
when base footing is below	=	ft

Increases based on footing Width

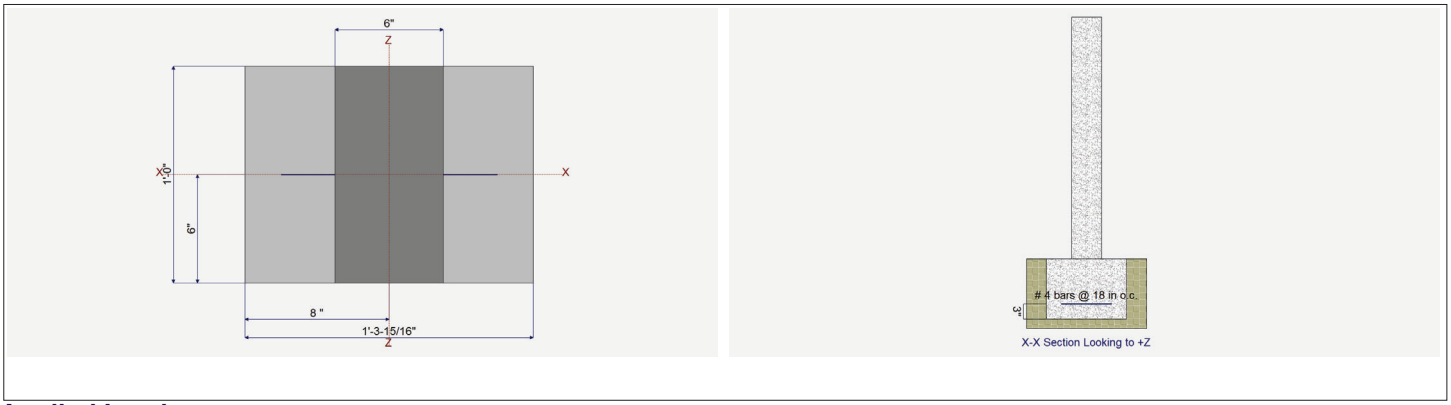
Allow. Pressure Increase per foot of width	=	ksf
when footing is wider than	=	ft

Adjusted Allowable Bearing Pressure = 2.0 ksf

Dimensions

Footing Width	=	1.33 ft	Footing Thickness	=	12.0 in	Bars along X-X Axis	
Wall Thickness	=	6.0 in	Rebar Centerline to Edge of Concrete...			Bar spacing	= 18.00
Wall center offset from center of footing	=	0 in	at Bottom of footing	=	3.0 in	Reinforcing Bar Size	= # 4

Reinforcing



Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	0.450		0.60	0.450				k
OB : Overburden	=								ksf
V-x	=								k
M-zz	=								k-ft

Vx applied = in above top of footing

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Wall Footing

Project File: cheshire framing 20241204.ec6

DESCRIPTION: TYPICAL STRIP FOOTINGS (INTERIOR & EXTERIOR)

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.5377	Soil Bearing	1.075 ksf	2.0 ksf	+D+0.750L+0.750S
PASS	0.02387	Z Flexure (+X)	0.1267 k-ft	5.306 k-ft	+1.20D+1.60L+0.50S
PASS	0.007060	Z Flexure (-X)	0.03746 k-ft	5.306 k-ft	+0.90D
PASS	n/a	1-way Shear (+X)	0.0 psi	75.0 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Actual Soil Bearing Stress -X	Actual Soil Bearing Stress +X	Actual / Allowable Ratio
, D Only	2.0 ksf	0.0 in	0.4833 ksf	0.4833 ksf	0.242
, +D+L	2.0 ksf	0.0 in	0.9345 ksf	0.9345 ksf	0.467
, +D+S	2.0 ksf	0.0 in	0.8217 ksf	0.8217 ksf	0.411
, +D+0.750L	2.0 ksf	0.0 in	0.8217 ksf	0.8217 ksf	0.411
, +D+0.750L+0.750S	2.0 ksf	0.0 in	1.075 ksf	1.075 ksf	0.538
, +0.60D	2.0 ksf	0.0 in	0.290 ksf	0.290 ksf	0.145

Overturning Stability

Units : k-ft

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Sliding SafetyRatio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot. or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
, +1.40D	0.05827	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.40D	0.05827	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L	0.1121	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L	0.1121	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L+0.50S	0.1267	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L+0.50S	0.1267	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L	0.06937	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L	0.06937	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D	0.04995	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D	0.04995	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+1.60S	0.116	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+1.60S	0.116	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60S	0.09656	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60S	0.09656	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.50S	0.08394	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.50S	0.08394	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.70S	0.08977	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.70S	0.08977	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +0.90D	0.03746	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +0.90D	0.03746	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK

One Way Shear

Units : k

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60L	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60L+0.50S	0 psi	0 psi	0 psi	75 psi	0	OK

Wall Footing

DESCRIPTION: TYPICAL STRIP FOOTINGS (INTERIOR & EXTERIOR)

One Way Shear

Units : k

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.20D+0.50L	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+1.60S	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60S	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.50S	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.70S	0 psi	0 psi	0 psi	75 psi	0	OK
+0.90D	0 psi	0 psi	0 psi	75 psi	0	OK

ASCE 7-16 Wind Forces Chpt 28, Pt2 & Chpt 30, Pt2

DESCRIPTIO Wind forces - Mercer Island

General Design Values

Calculations per ASCE 7-16

V : Basic Wind Speed per Sect 26.5-1 or 2	**110.0**	mph
User specified minimum design pressu	10.0	psf
Occupancy per Table 1.5-1	II	All Buildings and other structures except those listed
Exposure Category per 26.7	Exposure C	
Topographic Factor Kzt per 26.8	**1.00**	

Main Force Resisting System Valu

MRH : Mean Roof Height	30.0	ft
Roof Slope Angle	0 to 5	degrees

Component & Cladding Values

Effective Wind Area of Component & Clad	10.0	ft^2
Roof pitch for cladding pressu	Flat/Hip/Gable Roof	
LHD : Least Horizontal Dimension	40.0	ft
a = max (0.04 * LHD, 3, min(0.10 * LHD, 0.4*MRH))	**4.00**	ft

Lambda MWFRS: per Figure 26. **1.40**

Lambda Componant & Cladding : per Figur **1.40**

Design Wind Pressures

Horizontal Pressures . . .

Zone: A =	26.88 psf		Zone: C =	17.78 psf	
Zone: B =	-14.00 psf		Zone: D =	-10.00 psf	

Vertical Pressures . . .

Zone: E =	-32.34 psf		Zone: G =	-22.40 psf	
Zone: F =	-18.34 psf		Zone: H =	-14.14 psf	

Overhangs . . .

Zone: Eoh =	-45.22 psf		Zone: Goh =	-35.42 psf	

ASCE 7-16 Section 28.5.4 Minimum Design Wind Loads requires that the load effects of the design wind pressures from Section 28.5.3 shall not be less than a minimum load defined by assuming the pressures, ps, for zones A and C equal to +16 psf, Zones B and D equal to +8 psf, while assuming ps for Zones E, F, G, and H are equal to 0 psf.

Component & Cladding Design Wind Press

*Design Wind Pressure = Lambda * Kzt * Ps30 pe*

Roof Pressures	Positive	Negative		Overhang Pressures	Negative	
Zone 1	12.460	-48.580	psf	Zone 1	***	psf
Zone 1'	12.460	-27.860	psf	Zone 1'	***	psf
Zone 2	12.460	-63.980	psf	Zone 2	-53.900	psf
Zone 2e	***	***	psf	Zone 2e	***	psf
Zone 2n	***	***	psf	Zone 2n	***	psf
Zone 2r	***	***	psf	Zone 2r	***	psf
Zone 3	12.460	-87.220	psf	Zone 3	-73.080	psf
Zone 3e	***	***	psf	Zone 3e	***	psf
Zone 3r	***	***	psf	Zone 3r	***	psf

Wall Pressures

Wall Zone 4 :	***	***	psf
Wall Zone 5 :	***	***	psf

'*** : There is no value in Figure 30.4-1 Tabular Values

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

ASCE 7-16 Seismic Base Shear

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30 Merrell Design Services PLLC (c) ENERCALC INC 1983-2023

DESCRIPTION: Seismic Base Shear Analysis

Specific Description: Cheshire #2

Risk Category

Calculations per ASCE 7-16

Risk Category of Building or Other Structure : "II" : All Buildings and other structures except those listed as Category I, III, and IV — *SCE 7-16, Page 4, Table 1.5-1*

Seismic Importance Factor = 1 — *ASCE 7-16, Page 5, Table 1.5-2*

USER DEFINED Ground Motion

ASCE 7-16 11.4.2

Max. Ground Motions, 5% Damping

S_S = 1.630 g, 0.2 sec response
S_1 = 0.620 g, 1.0 sec response

For the closest datapoint grid location . . .

Latitude = 0.000 deg North
Longitude = 0.000 deg West

Site Class, Site Coeff. and Design Category

Classification: "D" : Shear Wave Velocity 600 to 1,200 ft/sec		=	**D** (Based on Testing)	*ASCE 7-16 Table 20.3-1*
Site Coefficients Fa & Fv	Fa	=	1.00	*ASCE 7-16 Table 11.4-1 & 11.4-2*
(using straight-line interpolation from table val	Fv	=	1.70	
Maximum Considered Earthquake Accelerat	S_{MS} = Fa * Ss	=	1.630	*ASCE 7-16 Eq. 11.4-1*
	S_{M1} = Fv * S1	=	1.054	*ASCE 7-16 Eq. 11.4-2*
Design Spectral Acceleration	$S_{DS} = S_{MS} * 2/3$	=	1.087	*ASCE 7-16 Eq. 11.4-3*
	$S_{D1} = S_{M1} * 2/3$	=	0.703	*ASCE 7-16 Eq. 11.4-4*
Seismic Design Category		=	**D**	*ASCE 7-16 Table 11.6-1 & -2*

Resisting System

ASCE 7-16 Table 12.2-1

Basic Seismic Force Resisting System . . . **Bearing Wall Systems**
15.Light-frame (wood) walls sheathed w/wood structural panels rated for shear resistance.

Response Modification Coefficient " R " = 6.50
System Overstrength Factor " Wo " = 3.00
Deflection Amplification Factor " Cd " = 4.00

NOTE! See ASCE 7-16 for all applicable footnc

Building height Limits :

Category "A & B" Limit:	No Limit
Category "C" Limit:	No Limit
Category "D" Limit:	Limit = 65
Category "E" Limit:	Limit = 65
Category "F" Limit:	Limit = 65

Lateral Force Procedure

ASCE 7-16 Section 12.8.2

Equivalent Lateral Force Procedure

The "Equivalent Lateral Force Procedure" is being used according to the provisions of ASCE 7-16 12.8

Determine Building Period

Use ASCE 12.8-7

Structure Type for Building Period Calcula All Other Structural Systems

" Ct " value = 0.020 " hn " : Height from base to highest leve 20.0 ft
" x " value = 0.75
" Ta " Approximate fundemental period using Eq. 12.8-7 : Ta = Ct * (hn ^ x) = 0.189 sec
"TL" : Long-period transition period per ASCE 7-16 Maps 22-14 -> 22-17 6.000 sec

Building Period " Ta " Calculated from Approximate Method sele = 0.189

" Cs " Response Coefficient

ASCE 7-16 Section 12.8.1.1

S_{DS} : Short Period Design Spectral Response	=	1.087	From Eq. 12.8-2, Preliminary Cs	=	0.167
" R " : Response Modification Factor	=	6.50	From Eq. 12.8-3 & 12.8-4 , Cs need not exce	=	0.572
" I " : Seismic Importance Factor	=	1	From Eq. 12.8-5 & 12.8-6, Cs not be less than	=	0.048

Cs : Seismic Response Coefficient = = **0.1672**

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

ASCE 7-16 Seismic Base Shear

Project File: cheshire framing 20241204.ec6

DESCRIPTION: Seismic Base Shear Analysis

Seismic Base Shear

ASCE 7-16 Section 12.8.1

Cs = 0.1672 from 12.8.1.1

W (see Sum Wi below) = 118.20 k

Seismic Base Shear V = Cs * W = 19.76 k

Vertical Distribution of Seismic Forces

ASCE 7-16 Section 12.8.3

" k " : hx exponent based on Ta = 1.00

Table of building Weights by Floor Level...

Level #	Wi : Weight	Hi : Height	(Wi * Hi^k)	Cvx	Fx=Cvx * V	Sum Story Shear	Sum Story Moment
2	52.00	22.00	1,144.00	0.6110	12.07	12.07	0.00
1	66.20	11.00	728.20	0.3890	7.69	19.76	132.82

Sum Wi = 118.20 k Sum Wi * Hi = 1,872.20 k-ft Total Base Shear = 19.76 k

Base Moment = 350.2 k-ft

Diaphragm Forces : Seismic Design Category "B" to "F"

ASCE 7-16 12.10.1.1

Level #	Wi	Fi	Sum Fi	Sum Wi	Fpx : Calcd	Fpx : Min	Fpx : Max	Fpx	Dsgn. Force
2	52.00	12.07	12.07	52.00	12.07	11.30	22.60	12.07	12.07
1	66.20	7.69	19.76	118.20	11.07	14.39	28.77	14.39	14.39

Wpx . . . . . Weight at level of diaphragm and other structure elements attached to it.
Fi . . . . . Design Lateral Force applied at the level.
Sum Fi . . . . . Sum of "Lat. Force" of current level plus all levels above
MIN Req'd Force @ Level . . . $0.20 * S_{DS} * I * Wpx$
MAX Req'd Force @ Level . . . $0.40 * S_{DS} * I * Wpx$
Fpx : Design Force @ Level . Wpx * SUM(x->n) Fi / SUM(x->n) wi, x = Current level, n = Top Level

Lateral Force Distribution

Main Wind Force (ult):	23.9 psf	(zone c)
Main Wind Force (service):	14.34 psf	(zone c)
Bldg Width	50 ft	
Bldg Length	78 ft	
1st Flr Width	50 ft	
2nd Flr Length	78 ft	

Seismic Mass

Roof	51996 lbs
2nd	66252 lbs
Cs	0.1672

					Transverse Loads		Longitudinal Loads		
Level	Seismic Weight	Seismic Force	Service Level Forces	Wind Trib ht	Svc Lvl EQ Unit Forces Trans	Service Wind Loads Trans	Svc Lvl EQ Unit Forces Long	Service Wind Loads Long	Floor ht
	(k)	(k)	(k)	ft	lbs/ft	lbs/ft	lbs/ft	lbs/ft	ft
Roof	51996	12.07	8.45	6.5	**108**	**93**	**169**	**93**	11
2nd	66252	7.69	5.38	11	**69**	**158**	**108**	**158**	11
Total		**19.76**	**13.83**						

Wind loads control transverse forces — Transverse Wind Total **19.6** k

Seismic loads control longitudinal forces — Longitudinal Seismic Total **13.8** k

Transverse Direction Shear Walls

Grid	Roof Trib width (ft)	Roof (lbs)	Lenth of SW (ft)	2nd floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type	1st Trib width (sq ft)	1st Floor (lbs)	Lenth of SW (ft)	1st Floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type
1	9	839	13	**65**	**W6**	**178**	**0**	**NA**	9	2259	13	**174**	**W6**	**356**	**0**	**NA**
2	12	1119	18	**62**	**G7**	**187**	**0**	**NA**	12	3011	18	**167**	**2G4**	**374**	**0**	**NA**
3	14	1305	28.5	**46**	**G7**	**205**	**0**	**NA**	14	3513	28.5	**123**	**2G4**	**410**	**0**	**NA**
4	14	1305	24.5	**53**	**G7**	**205**	**0**	**NA**	14	3513	24.5	**143**	**2G4**	**410**	**0**	**NA**
5	12	1119	24.5	**46**	**G7**	**187**	**0**	**NA**	12	3011	24.5	**123**	**2G4**	**374**	**0**	**NA**
6	9	839	6.5	**129**	**W6**	**178**	**524**	**MSTI48**	9	2259	6.5	**347**	**W4**	**356**	**4255**	**HDU5**

Longitudinal Direction Shear Walls

Grid	Roof Trib width (ft)	Roof (lbs)	Lenth of SW (ft)	2nd floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type	1st Trib width (sq ft)	1st Floor (lbs)	Lenth of SW (ft)	1st Floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type
A/B	14	2366	13.87	**171**	**W6**	**106**	**1140**	**MSTI48**	14	3873	13.87	**450**	**W3**	**203**	**0**	**NA**
B.3	11	1859	7	**266**	**W6**	**106**	**2549**	**MSTI48**	11	3043	8	**613**	**W2**	**203**	**5026**	**HDU5**
B.7	11	1859	7	**266**	**W6**	**106**	**2549**	**MSTI48**	11	3043	8	**613**	**W2**	**203**	**5026**	**HDU5**
C/D	14	2366	(6) Cant Cols	**NA**	**Cant C**	**106**	**NA**	**NA**	14	3873	28.67	**218**	**W6**	**203**	**0**	**NA**

Global Lateral Resistance

Helical anchors are to be utilized for global lateral resistance of the building and foundation.

Helical Anchors Allowable Soil Capacity ((2) 12" dia helices w/ 4.5" shaft) 40000 lbs (Per Earth Solutions NW, Inc)

North-South and East-West Direction:

Global lateral load (controlling)	19574 lbs
Helical Lateral capacity at 3:1	12658 lbs
Min No of Helicals Each dir	2
Actual Pile Demand	10309 lbs

Due to geometric footprint provide (6) helicals in N-S dir with 1 at grid 1, 2 at grid 3 and 4 and 1 at grid 6.

Due to geometric footprint provide (6) helicals in E-W dir with 1 at grid A, 2 at grid B and C and 1 at grid D.

Punching shear check (ACI 22.6.5.2)

depth, d	5 in	
Conc strength, f'c	2500 psi	
Critical section, bo	44 in	
phi	0.75	
phi*Vc	33000 lbs	< 10309 lbs, OK

Table 22.6.5.2—Calculation of v_c for two-way shear

v_c		
Least of (a), (b), and (c):	$4\lambda\sqrt{f'_c}$	(a)
	$\left(2+\frac{4}{\beta}\right)\lambda\sqrt{f'_c}$	(b)
	$\left(2+\frac{\alpha_s d}{b_o}\right)\lambda\sqrt{f'_c}$	(c)

REV 3

Using Table 12.2b. the shaft size or sizes with the required Rated Torsional Capacity can be selected. We recommend limiting the estimated required torque to a value somewhat less than the Rated Torsional Capacity. This will facilitate installation when unexpected hard layers are encountered.

The values of K_t shown below are intended to assist the designer in selecting the proper shaft size for the particular application. Larger values of K_t can provide greater geotechnical pile capacities, but Design Loads should not induce: (1) stresses into the shaft which exceed one-half of the Yield Strength shown in Table 12.1 or (2) Helix loads exceeding the values shown in Table 12.3.

Table 12.2a.
HELICAL PRODUCT MECHANICAL CAPACITIES

Shaft Size	Pile Shaft Designation	Rated Torsional Capacity (ft-lbs)[1]	Ultimate Mechanical Shaft Capacities for Axial Loading (lbs)[2]
1.50” Square Shaft	D6/S6	5,500	68,000
1.50” Square Shaft (high str.)	D7/S7	7,000	70,000
1.75” Square Shaft	D10/S10	10,000	100,000
2.00” Square Shaft	D15/S15	15,000	150,000
2.875” O.D. (0.203” wall)	P28/R28	6,700	70,000
2.875” O.D. (0.276” wall)	P28H/R28H	8,000	90,000
3.500” O.D. (0.216” wall)	P35/R35	11,400	100,000
3.500” O.D. (0.300” wall)	P35H/R35H	15,000	120,000
4.500” O.D. (0.237” wall)	P45/R45	20,000	130,000
4.500” O.D. (0.337” wall)	P45H/R45H	26,000	180,000
8.625” O.D. (0.1875” wall)	R86L	40,000	200,000 compression[3] / 120,000 tension

[1] Rated torsional capacity is based on strength of materials resisting torsional forces.
[2] Mechanical capacity for axial loads are based on strength of materials of the pile to resist axial (compression and tension) loading. Actual in place loads may not reach the ultimate mechanical capacities due to soil types, helix configuration or design methodology.

[3] Higher axial resistance may require filling the pile shaft with grout and possibly rebar following installation.

Table 12.2b.
ULTIMATE GEOTECHNICAL CAPACITIES

Shaft Size	Pile Shaft Designation	Kt[4]	Rated Torsional Capacity (ft-lbs)[5]	Estimated Geotechnical capacities per torque correlation[6]			
				Ultimate Capacity[7]		Maximum Design Load[8]	
				Tension	Compression	Tension	Compression
				(lbs)	(lbs)	(lbs)	(lbs)
1.50” Square Shaft	D6/S6	10	5,500	55,000	55,000	27,500	27,500
1.50” Square Shaft (high str.)	D7/S7	10	7,000	70,000	70,000	35,000	35,000
1.75” Square Shaft	D10/S10	10	10,000	100,000	100,000	50,000	50,000
2.00” Square Shaft	D15/S15	10	15,000	150,000	150,000	75,000	75,000
2.875” O.D. (0.203” wall)	P28/R28	9	6,700	60,000	60,000	30,000	30,000
2.875” O.D. (0.276” wall)	P28H/R28H	9	8,000	72,000	72,000	36,000	36,000
3.500” O.D. (0.216” wall)	P35/R35	7	11,400	80,000	80,000	40,000	40,000
3.500” O.D. (0.300” wall)	P35H/R35H	7	15,000	105,000	105,000	52,500	52,500
4.500” O.D. (0.237” wall)	P45/R45	6	20,000	120,000	120,000	60,000	60,000
4.500” O.D. (0.337” wall)	P45H/R45H	6	26,000	156,000	156,000	78,000	78,000
8.625” O.D. (0.1875” wall)[9]	R86L	5	40,000	120,000[10]	200,000	60,000	100,000

13,000 ft-lbs per Geotech recommendations for 80 kip ult capacity

[4] Torque correlation factor or Kt value is based on empirical data collected from loading test studies in numerous soil types and industry standards. Actual Kt factors may be lower or higher based on soil condition. If a higher Kt factor is utilized, it is recommended to verify the modified Kt factor with a documented ASTM load test program.
[5] Rated torsional capacity is based on strength of materials resisting torsional forces.
[6] Geotechnical pile capacity per torque correlation is based on maximum torsional capacity multiplied by referenced torque correlation factor to estimate maximum axial capacities when the torque correlation method is employed for design or verification. See section 13 for further explanation.
[7] Ultimate capacity derived from the torque correlation method.
[8] Design load reflects 0.5 of ultimate capacity or a safety factor of 2.
[9] Wall thickness of 0.25” and 0.322 are available upon request as a custom design for required higher load resistance.
[10] Tension load is controlled by connecting bolt capacity in tension.

Table 12.4
PROPERTIES FOR SHAFTS AND COUPLINGS

Shafts	1.50" Round Corner Square Shaft	1.50" Round Corner Square Shaft	1.75" Round Corner Square Shaft	2.00" Round Corner Square Shaft	2.875" O.D. Pipe Shaft		3.50" O.D. Pipe Shaft		4.50" O.D. Pipe Shaft		8.625" O.D. Pipe Shaft
					0.203" wall	0.276" wall	0.216" wall	0.300" Wall	0.237" wall	0.337" wall	0.188" Wall
Yield strength; ksi	70	90	90	90	50	50	50	50	50	50	50
Section area; in^2	2.190	2.190	3.010	3.940	1.704	2.253	2.228	3.016	3.174	4.407	4.970
Perimeter; in	5.571	5.571	6.571	7.571	9.032	9.032	10.996	10.996	14.137	14.137	27.096
Moment of inertia, Ixx=Iyy=Ixy; in^4	0.396	0.396	0.746	1.260	1.530	1.924	3.017	3.894	7.233	9.611	44.250
Section modulus, Sxx=Syy; in^3	0.528	0.528	0.853	1.260	1.064	1.339	1.724	2.225	3.214	4.271	10.261
Section modulus, Sxy; in^3	0.414	0.414	0.657	0.980	1.064	1.339	1.724	2.225	3.214	4.271	10.261
Coupling											
Forged	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No
Cast steel SC 1045; ksi (yield/tensile)	NA	NA	NA	NA	40/80	40/80	40/80	40/80	40/80	40/80	NA
Bolt(s) Dia.* ASTM A325	0.750	0.750	0.875	NA	0.750	0.750	0.875	0.875	1	1	1
Bolt(s) Dia.* SAE J429	NA	NA	NA	1.125	NA	NA	NA	NA	NA	NA	NA
Bolt qty. (ea)	1	1	1	1	2	2	2	2	2	2	4
Transition*											
*Pipe to RCS***	NA	NA	NA	NA	1.5	1.5	1.75	1.75	2	2	NA

* Bolt diameter in inches.
** To specify transition pile, add the suffix "X" on catalog number.
*** Use same coupling bolt shown for RCS.

Table 12.5
HELIX NET BEARING AREAS (ft^2) *

Nominal diameter (in)	1.50" Round Corner Square Shaft	1.50" Round Corner Square Shaft	1.75" Round Corner Square Shaft	2.00" Round Corner Square Shaft	2.875" O.D. Pipe Shaft		3.50" O.D. Pipe Shaft		4.50" O.D. Pipe Shaft		8.625" O.D. Pipe Shaft
					0.203" wall	0.276" wall	0.216" wall	0.300" wall	0.237" wall	0.337" wall	0.188" Wall
8	0.308	0.308	0.303	0.296	0.300	0.300	0.278	0.278	0.236	0.236	NA
10	0.501	0.501	0.495	0.489	0.494	0.494	0.473	0.473	0.430	0.430	NA
12	0.724	0.724	0.719	0.712	0.732	0.732	0.711	0.711	0.668	0.668	NA
14	1.002	1.002	0.996	0.990	1.014	1.014	0.993	0.993	0.950	0.950	0.659
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.984
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.766
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.719

* Shaft areas have been deducted.

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft

Code Reference

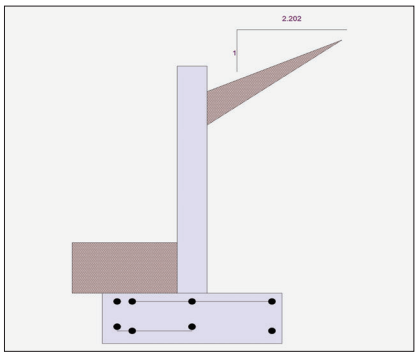
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	2.20
Height of Soil over Toe	=	12.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Coulomb Soil Pressure calculation		
Soil Friction Angle	=	30.0 deg
Active Pressure:		
Ka*Gamma (horiz)	=	49.0 psf/ft
Passive Pressure:Kp*Gar	=	552.8 psf/ft
Soil Density, Heel	=	115.00 pcf
Soil Density, Toe	=	115.00 pcf
Footing||Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform		
Multiplier Used	=	8.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	44.541
Total Seismic Force	=	247.991

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft

Design Summary

Wall Stability Ratios

Overturning	=	1.45	Ratio < 1.5!
Sliding	=	1.68	OK
Global Stability	=	3.07	

Total Bearing Load	=	1,986	lbs
...resultant ecc.	=	11.41	in

Eccentricity outside middle third

Soil Pressure @ Toe	=	1,879	psf OK
Soil Pressure @ Heel	=	0	psf OK
Allowable	=	2,000	psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,630	psf
ACI Factored @ Heel	=	0	psf
Footing Shear @ Toe	=	9.7	psi OK
Footing Shear @ Heel	=	8.5	psi OK
Allowable	=	75.0	psi

Sliding Calcs

Lateral Sliding Force	=	933.1	lbs
less 100% Passive Force	-	1,105.6	lbs
less 100% Friction Force	-	464.1	lbs
Added Force Req'd	=	0.0	lbs OK
....for 1.5 Stability	=	0.0	lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	6.00		
Rebar Size	=	# 4		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Center		
Design Data				
fb/FB + fa/Fa	=	**0.479**		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	805.4		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	1,192.7		
Moment.....Allowable	=	2,487.6		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	22.4		
Shear.....Allowable	psi =	75.0		
Anet (Masonry)	in2 =			
Wall Weight	psf =	75.0		
Rebar Depth 'd'	in =	3.00		

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0988 in2/ft		
(4/3) * As :	0.1318 in2/ft	Min Stem T&S Reinf Area 0.648 in2	
200bd/fy : 200(12)(3)/60000 :	0.12 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.12 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.4064 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Data

Toe Width	=	1.25 ft
Heel Width	=	1.75
Total Footing Width	=	3.00
Footing Thickness	=	12.00 in

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,630	0	psf
Mu' : Upward	=	1,535	0	ft-#
Mu' : Downward	=	248	613	ft-#
Mu: Design	=	1,287	613	ft-#
phiMn	=	9,777	10,944	ft-#
Actual 1-Way Shear	=	9.74	8.46	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.35 in
Heel Reinforcing = # 5 @ 14.35 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 0.78 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		759.5	1.86	1,409.6	Soil Over HL (ab. water tbl)	575.0	2.38	1,365.6
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.38	1,365.6
Hydrostatic Force					Water Table			
Buoyant Force	=				Sloped Soil Over Heel	= 40.8	2.58	105.4
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	= 143.8	0.63	89.8
Seismic Earth Load	=	173.6	2.78	483.3	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 337.5	1.50	506.3
					Earth @ Stem Transitions	=		
					Footing Weight	= 450.0	1.50	675.0
					Key Weight	=		
					Vert. Component	=		
Total	=	933.1	**O.T.M.** =	1,892.9	**Total =**	1,547.1 lbs	**R.M.=**	2,742.1

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Resisting/Overturning Ratio = **1.45**
Vertical Loads used for Soil Pressure = 1,985.6 lbs

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.078	in

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	6.00 in
As Provided =	0.2000 in2/ft
As Required =	0.1200 in2/ft

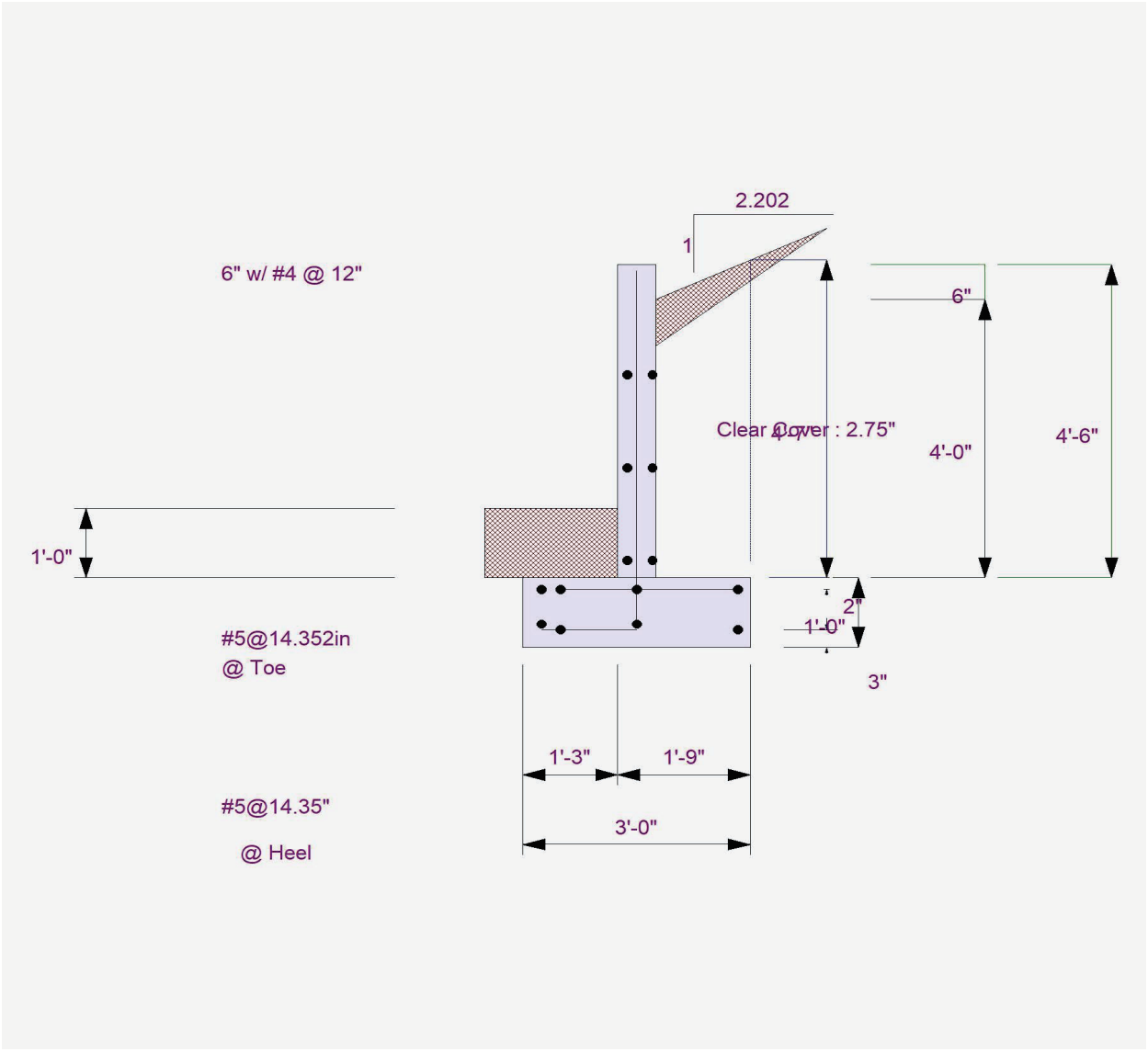
Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft



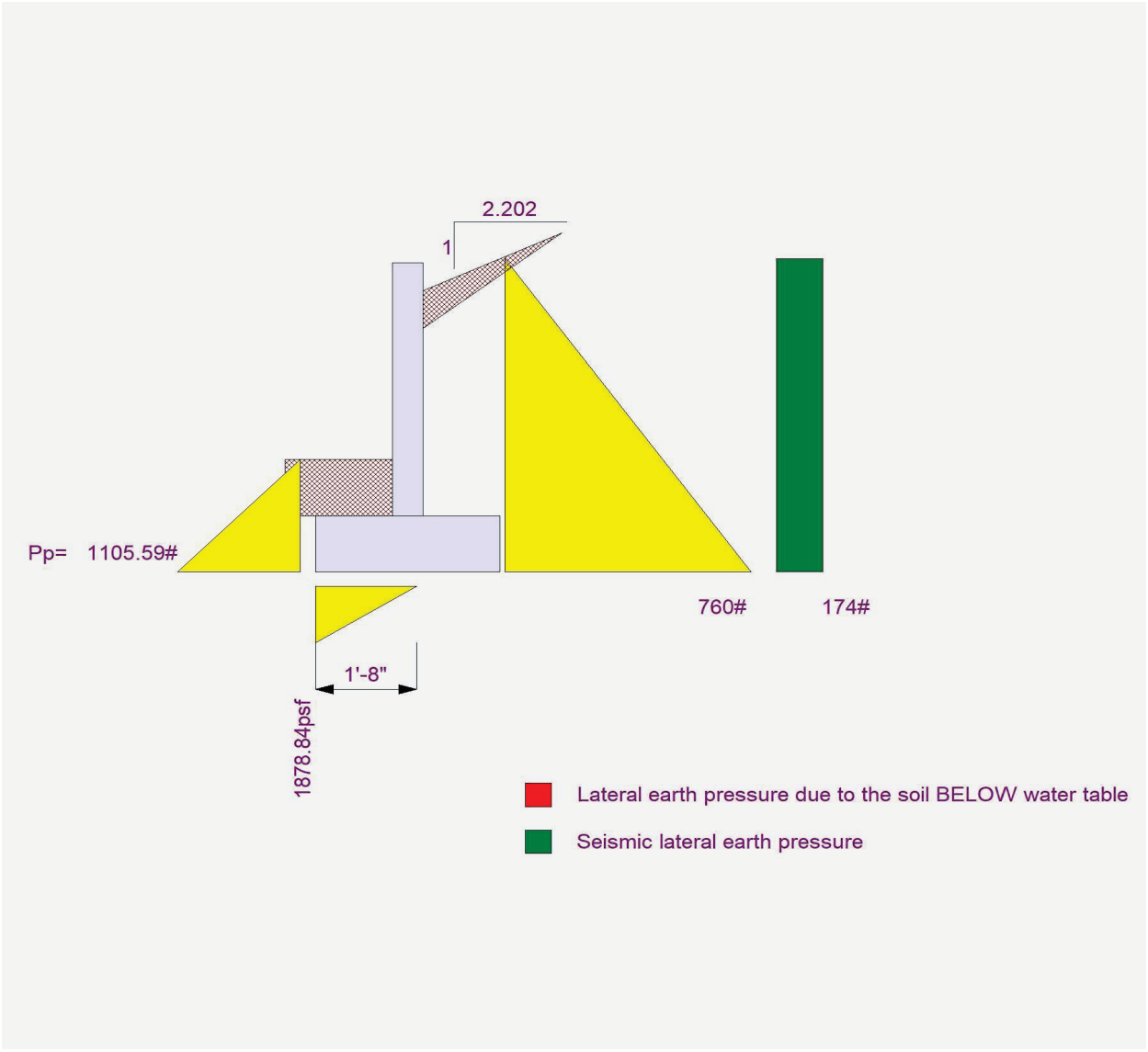
Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: Site Retaining Walls 4ft



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)

Code Reference

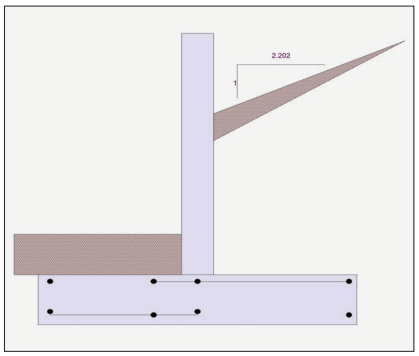
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	2.00 ft
Slope Behind Wall	=	2.20
Height of Soil over Toe	=	12.00 in
Water table above bottom of footing	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,667.0 psf
Coulomb Soil Pressure calculation		
Soil Friction Angle	=	30.0 deg
Active Pressure:		
Ka*Gamma (horiz)	=	49.0 psf/ft
Passive Pressure:Kp*Gar	=	552.8 psf/ft
Soil Density, Heel	=	115.00 pcf
Soil Density, Toe	=	115.00 pcf
Footing||Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	600.0 #/ft
...Height to Top	=	6.00 ft
...Height to Bottom	=	4.00 ft
Load Type	=	Earth (H) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)

Design Summary

SF=1.2 OK PER EARTH SOLUTIONS NW RECOMENDATION

Wall Stability Ratios

Overturning	=	1.96	OK
Sliding	=	1.20	Ratio < 1.5!
Global Stability	=	2.49	

Total Bearing Load	=	4,432 lbs	
...resultant ecc.	=	23.34 in	
Eccentricity outside middle third			
Soil Pressure @ Toe	=	1,828 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	2,667 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,560 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	22.5 psi	OK
Footing Shear @ Heel	=	16.9 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,271.8 lbs	
less 100% Passive Force	-	1,399.3 lbs	
less 100% Friction Force	-	1,329.5 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	679.0 lbs	NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	
Dead Load	1.200
Live Load	1.600
Earth, H	1.000
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	SD	SD	SD
Thickness	=	8.00		
Rebar Size	=	# 6		
Rebar Spacing	=	12.00		
Rebar Placed at	=	Center		

Design Data

fb/FB + fa/Fa	=	**0.946**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,592.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	6,522.7
Moment.....Allowable	=	6,892.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	33.2
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	4.00

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	2,500.0
Fy	psi =	60,000.0

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.3938 in2/ft		
(4/3) * As :	0.525 in2/ft	Min Stem T&S Reinf Area 1.152 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.3938 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.44 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.5419 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	3.00 ft
Heel Width	=	3.67
Total Footing Width	=	6.67
Footing Thickness	=	15.00 in

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,560	0	psf
Mu' : Upward	=	8,756	13	ft-#
Mu' : Downward	=	1,634	4,070	ft-#
Mu: Design	=	7,123	4,057	ft-#
phiMn	=	21,993	23,973	ft-#
Actual 1-Way Shear	=	22.55	16.92	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 6 @ 12.00 in
Heel Reinforcing = # 6 @ 12.00 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37.03 in, #10@ 47.03 in

Heel: #4@ 7.40 in, #5@ 11.48 in, #6@ 16.29 in, #7@ 22.22 in, #8@ 29.25 in, #9@ 37.03 in, #10@ 47.03 in

Key: No key defined

Min footing T&S reinf Area 2.16 in2
Min footing T&S reinf Area per foot 0.32 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 7.41 in	#4@ 14.81 in
#5@ 11.48 in	#5@ 22.96 in
#6@ 16.30 in	#6@ 32.59 in

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		1,071.8	2.20	2,363.0
HL Act Pres (be water tbl)				
Hydrostatic Force				
Buoyant Force	=			
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=	1,200.0	6.25	7,500.0
Load @ Stem Above Soil	=			
	=			
Total	=	2,271.8	**O.T.M.** =	9,863.0

Item		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Soil Over HL (ab. water tbl)		1,381.5	5.17	7,140.2
Soil Over HL (bel. water tbl)			5.17	7,140.2
Water Table				
Sloped Soil Over Heel	=	235.5	5.67	1,335.2
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	345.0	1.50	517.5
Surcharge Over Toe	=			
Stem Weight(s)	=	600.0	3.33	2,000.0
Earth @ Stem Transitions	=			
Footing Weight	=	1,250.6	3.34	4,170.8
Key Weight	=		3.00	
Vert. Component	=	618.8	6.67	4,127.5
	Total =	4,431.5 lbs	**R.M.=**	19,291.3

Resisting/Overturning Ratio = **1.96**
Vertical Loads used for Soil Pressure = 4,431.5 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.046	in

Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #6 bar specified in this stem design segment (25.4.2.3a) =	28.08 in
Development length for #6 bar specified in this stem design segment =	21.60 in
Hooked embedment length into footing for #6 bar specified in this stem design segment =	11.28 in
As Provided =	0.4400 in2/ft
As Required =	0.3938 in2/ft

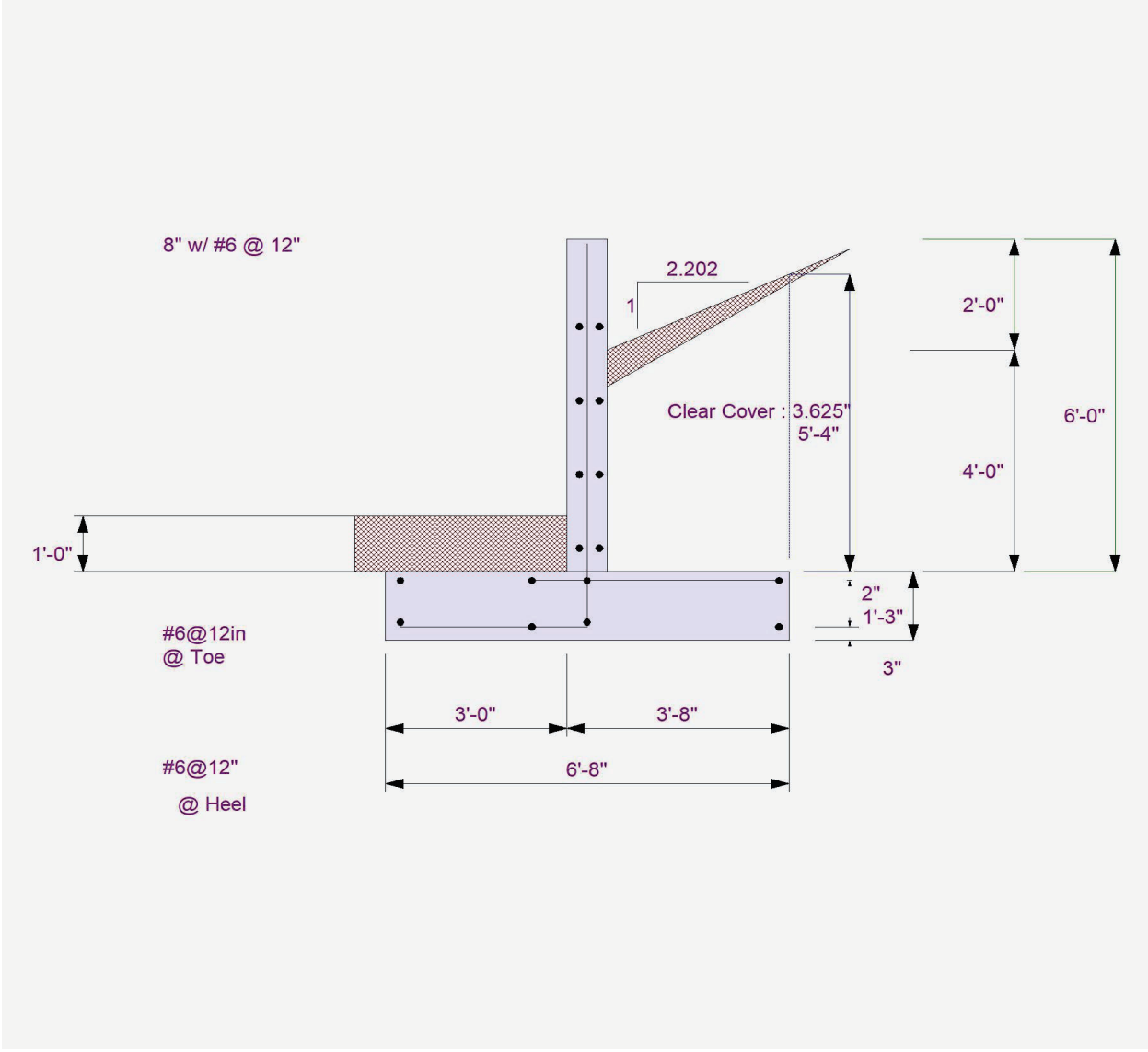
Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
Engineer: KJH
Project ID: 23-067
Project Descr: Two-Story Residence Fdns & Framing

Cantilevered Retaining Wall

Project File: cheshire framing 20250728.ec6

DESCRIPTION: 4ft Site Retaining Wallswith mobilized soil mass (1200 lb/ft)